4-1983

Dichoptic brightness asymmetry in relation to low stereoacuity

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Abstract

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Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Niles Roth

Subject Categories

Optometry

DICHOPTIC BRIGHTNESS ASYMMETRY IN RELATION TO LOW STEREOACUITY

A Thesis

Presented to

the Faculty of

Pacific University

In Partial Fulfillment of

the Requirements for the

Degree Master of Science in

Clinical Optometry (Management Track)

Submitted by

Jerry D. Davis, O.D.

April 1983

DICHOPTIC BRIGHTNESS ASYMMETRY

IN RELATION TO LOW STEREOACUITY

Place: Pacific University

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David R. Malcolm, Ph.D. — Date

ACKNOWLEDGEMENTS

Acknowledgement and sincere appreciation to Doctor Niles Roth for his selfless guidance, positive manner of counseling and constant encouragement; to the U.S. Army and Colonel Arthur Giroux for the opportunity and funding for this graduate education and to Joanna, Paige and Robin for their sacrifices in aiding my completion of this degree.

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ABSTRACT

It has been generally assumed that the two eyes of a normal observer provide equal inputs to the visual cortex for the sensation of brightness, since artificially produced unequal inputs result in distortion of binocular perception. This study measures the comparative brightness contributions of the two monocular inputs to the visual system at three different levels of luminance adaptation. Two groups of fifteen subjects each were evaluated, with the only known difference between these groups being stereothreshold (50-70 arcsec vs 40 arcsec or less). The group with elevated threshold was found to have a significantly larger mismatch in monocular brightness contributions (between the right and left eyes) when compared to the group with normal stereoacuity. The results also indicate that neither group showed a significant variation in mismatch as adapting luminance was altered by a factor of four (0.6 log units). Finally, there was found to be no clear relation between eye dominance and the eye requiring higher illuminance to attain the dichoptic brightness match.

LEGENDS FOR FIGURES

TABLE

* CMCB stands for Comparative Monocular Contributions to Brightness

INTRODUCTION, BACKGROUND AND SIGNIFICANCE

The study of how the two eyes coordinate with each other has captivated eye practitioners, neurologists and anatomists for hundreds of years, but today as much still remains unknown as has been discovered. Among several accepted requirements for normal binocular vision is one that implies comparable monocular brightness inputs to the visual cortex, i.e., when a normal binocular observer views a target of constant uniform luminance it is generally assumed that the preceived brightness of the target is a result of equal monocular inputs to the visual cortex. Although much previous work has been directed towards binocular summation (discussed below), until 1981 no one looked at the comparative contributions of the two monocular inputs to the visual system. In that year, in a fourth year optometry thesis by Corcoran (advisor Roth), it was reported that in normal binocular subjects the monocularly contributed brightnesses were equal within a two percent overall average for all subjects (N=13). The report concluded with the hypothesis that since normal binocular subjects did not show a significant difference in monocular brightness contributions, it is possible that certain visual anomalies (for example, low stereoacuity) will be significantly correlated with unequal monocular brightnesses. The foregoing hypothesis is the subject of the presently reported research, which was directed towards low stereoacuity.

The significance of this study is that if a positive relationship is found between visual anomalies and monocular brightness

mismatches, it might be possible to adapt this procedure to the areas of screening or even diagnosis of binocular dysfunctions, especially in borderline binocular problems.

REVIEW OF THE LITERATURE

It has been established that the monocular retinal illuminances can differ, in normal observers, by as much as 2.5 log units (more than a factor of 300) without complete loss of binocular vision, although distortion of visual space does result from imbalances as small as 0.1 log unit (26%).[1]

Binocular summation[2] is demonstrated by comparing monocular to binocular brightness of the same source, in which case binocular brightness appears greater than monocular. On the other hand an apparent contradiction of binocular summation is the Fechner Paradox[2] where an occluder over one eye is replaced by a dark filter, resulting in a decrease in brightness rather than the expected increase. In addition, effects of unequal retinal illuminance have been shown to reduce stereoacuity[3], alter the orientation of the apparent frontoparallel plane[4], and change the location of the binoculus or projection center.[5]

More recently visual evoked response (VER) studies of binocular summation have demonstrated that unequal retinal illuminances of 1.3 log units (factor of 20) or greater produce a binocular amplitude smaller than the monocular amplitude of either eye but at equal illuminances or with differences less than the 1.3 log units the binocular amplitude is greater than either of the two monocular amplitudes.[6] This finding is further evidence for the existence of a binocular process.

The existing literature demonstrates the effect on binocularity of unequal retinal illuminances, but, to date, the writer has found no published work on inherent differences in monocular contributions to brightness. However, from the above studies it is

conceivable that some binocular anomalies result from, or are related to, unequal monocular brightness inputs to the visual cortex.

STATEMENT OF THE PROBLEM

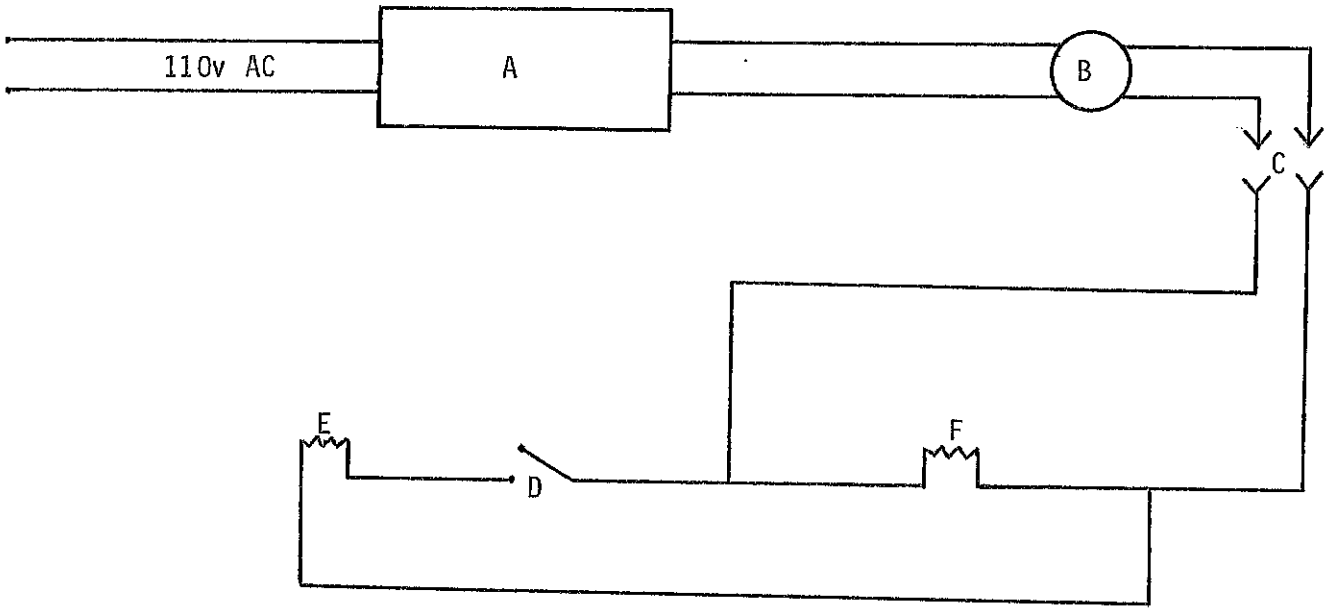
Previous research has shown that there is no more than a 10 percent asymmetry of monocular brightness contributions in normal binocular subjects. The present study evaluates the asymmetry of monocular brightness contributions in subjects with subnormal stereothresholds but who still demonstrate third degree fusion (stereoscopic depth perception).

The hypothesis is that there is no significant variation in monocular brightness contributions in either subjects with subnormal stereoacuity or in normal subjects when photopic adapting (surround) luminance is changed. This (null) hypothesis will be accepted if there is no significant variation in matching luminance ratio with adapting luminance in either group or if there is significant variation in ratio in both groups and at the same level of significance for both. The null hypothesis will be rejected if there is significant variation in ratio in the control group, but not in the experimental group or if there is significant variation in the experimental group, but not in the control group.

MATERIALS

The instrument used in this study was the Humphrey Vision Analyzer (HVA). The HVA is an instrument that is presently used in many eye practitioners' offices and has the advantage of expanding the usefulness of an existing instrument by means of relatively simple modifications. The HVA also has the advantage of not requiring the subject to look through small apertures, avoiding the limitations inherent in other systems that do not provide a natural viewing environment. Modifications necessary to collect the data were made as described below.

Due to fluctuations in standard 115 volt (v) household current and no constant voltage regulation in the HVA it was necessary to supply the required alternating current directly to the projector bulbs from an external source. For this modification a Raytheon VR3 "Voltage Stabilizer" was used to obtain more stable projector bulb light output. To reduce the 115v coming out of the VR3 down to the approximately 7.5v needed for the projector bulbs, a Superior Electric 3PN116B "Powerstat Variable Transformer" (PVT) was used. Wires from the PVT were connected to the projector bulbs of the HVA, bypassing the internal HVA power supply (Fig. 1). To allow normal operation of the HVA when not being used for this project, two modifications were necessary. Firstly, to prevent voltage from the internal power supply of the HVA getting to the projector lamps a switch was placed between the wiper arm of the HVA's rheostat (a built-in projector lamp controller) and the common supply lead to the projector lamps. Secondly, since one of the wires coming from the PVT attaches to both return leads of the right and left projector bulbs, it would be impossible, in normal use, to operate



A . . . Raytheon VR3 voltage stabilizer

B . . . Superior electric 3PN116B powerstat variable transformer

C . . . Connectors

D . . . Switch

E . . . Left projector bulb

F . . . Right projector bulb

Figure 1

Projector Lamp Power Supply

the projector bulbs individually with the internal power supply. Individual lamp operation is not necessary for the experimental procedure. In fact it is better to keep both bulbs constantly energized from start to finish of a day's run, because turning individual bulbs on and off destabilizes their outputs for some time thereafter (perhaps for an hour or longer). To remedy this, another switch was placed in the accessory wire going from the left bulb's return to the right bulb's return lead.

To control the light levels entering the right and left eyes, two sets of polarizing filters were used. The stationary filters were placed in the rectangular window where the two projector beams (right and left) exit the HVA console (Fig. 2). Two additional polarizers, one for each eye, and separately rotatable were located directly under the projector bulbs in the area where the projector slide (used in the normal operation of the HVA) is located. A 1/4 inch thick masonite plate was fabricated with two apertures (one for each channel) such that a round piece of polarizing material could be positioned in the beam of light and rotated to obtain varying degrees of attenuation for each channel. A metal rod with pointer was attached to each round filter with epoxy glue. This allowed approximately 60 degrees of rotation for each filter. Arcs were drawn at the locations of the pointers and a protractor was used to mark off the degrees of rotation for each filter. Marks were made on the arcs from 0 to 50 degrees in 5 degree increments for each filter (Fig. 3). The 0 degree mark for each filter is approximately equal to a 20 degree rotation of the polaroid filters from the point of maximum transmission, which then allows approximately a six fold (0.8 log units) change in luminous

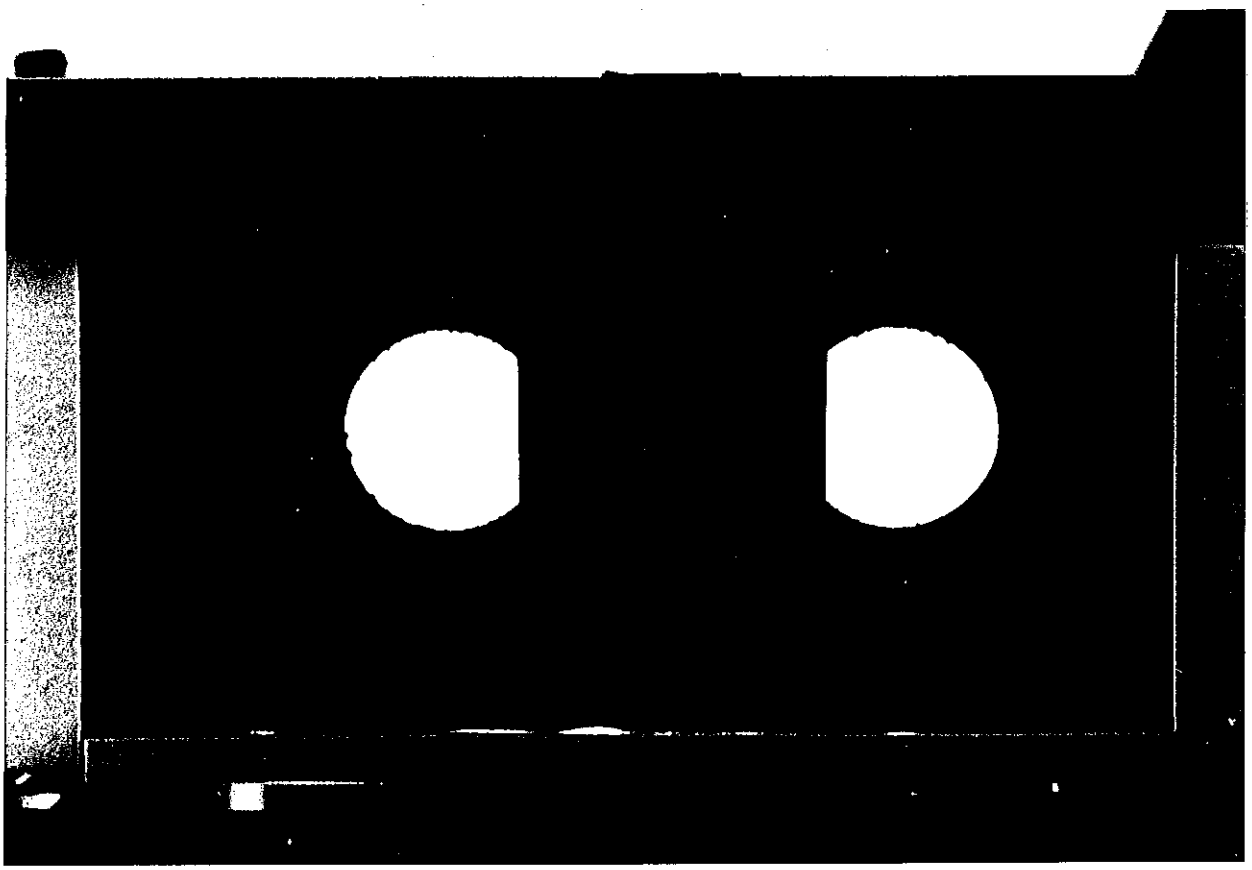


Figure 2 Polarizing Filter with Cardboard Mask

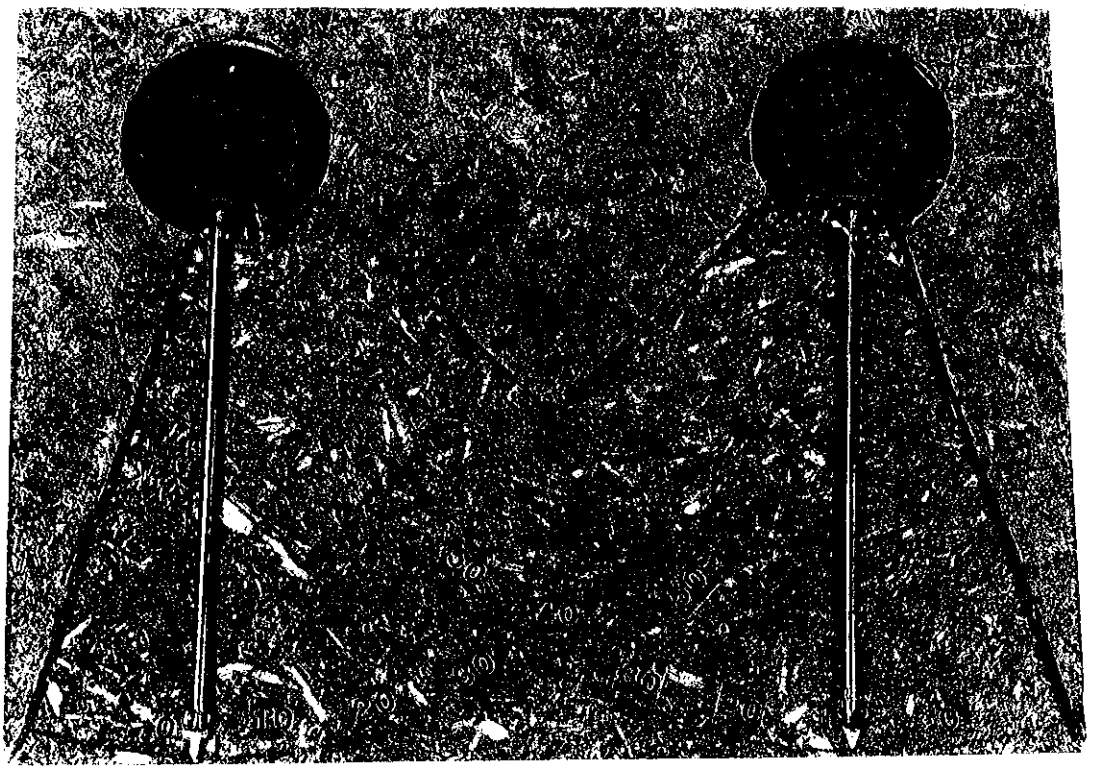


Figure 3 Rotating Polarizing Filters

flux density at the eye on going from 0 to 50 degrees on the scale.

To control the shapes of the two luminous test targets observed by the subject, a cardboard mask was cut out and attached to the polarizing filter at the exit window. The mask has two 3.8 cm diameter circles, each having one side flattened to a sagittal depth of about 1.0 cm with black photographic tape (Fig. 2).

To control the duration of simultaneous exposure of the targets a flap shutter was constructed of a sheet of 3 mm thick plastic mounted on a 25 cm length of 12.5 mm square aluminum rod attached to a Leedex solenoid Model S-8210-027 (Fig. 4). The solenoid, when activated, rotates 45 degrees. When the solenoid is not activated the plastic sheet makes an angle of 45 degrees with the floor, occluding the projector beams. When activated it parallels the floor, allowing the subject to view the two targets. A coil spring attached to one of the set screws that secures the bar to the solenoid, and to a bracket mounted to the base of the shutter apparatus, produces a strong positive return of the plastic sheet to the 45 degree position when the solenoid is inactivated. The solenoid requires direct current at well below the full voltage provided by standard electrical receptacles, so a rectifier and 120 ohm resistor were wired into its electrical circuit (Fig. 5). The entire shutter mechanism was mounted on a short stand and located directly in front of the exit window of the HVA (Fig. 4).

To control the length of time the solenoid would be activated a three-cam recycling timer was used. Each cam controlled a separate switch, one of which was a starting and stopping switch controlling the drive motor. A manual starter switch began the shutter cycle, which was then brought under immediate control of

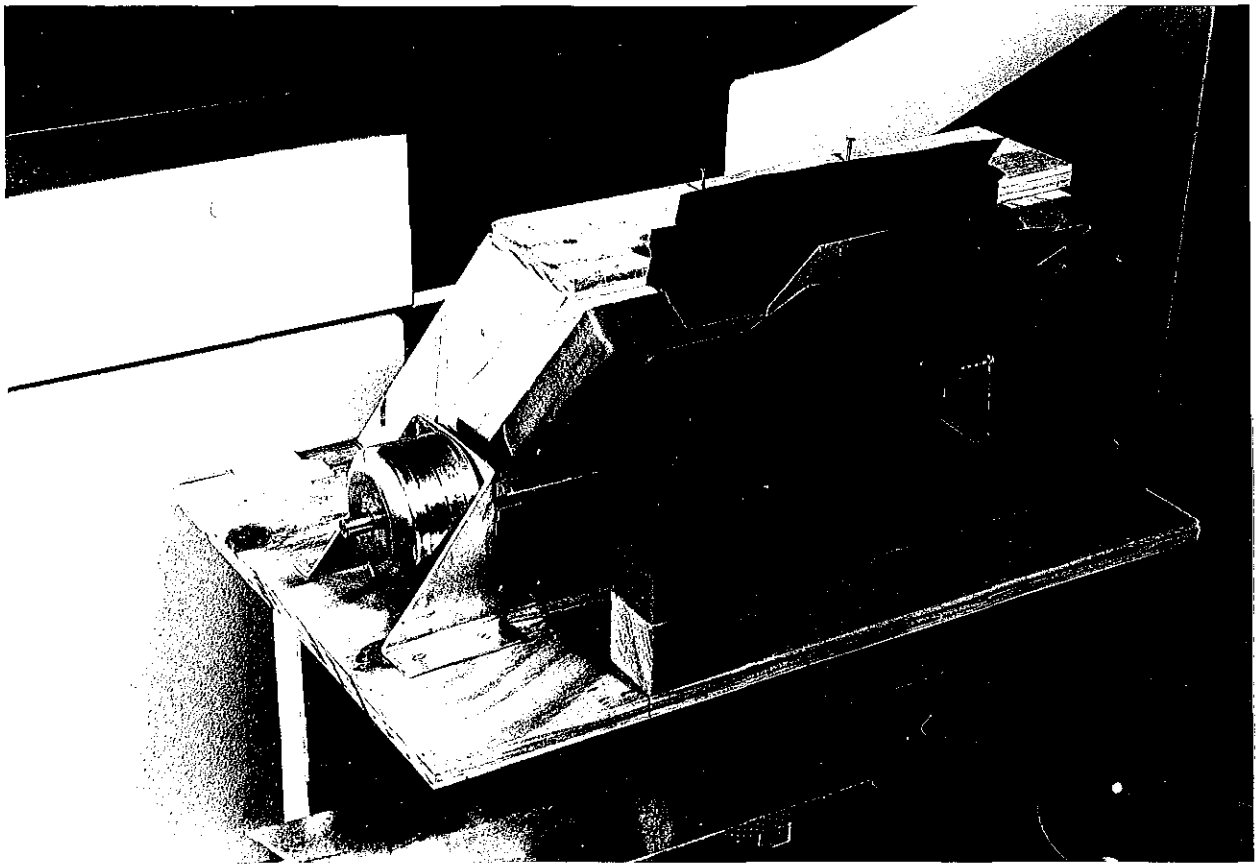
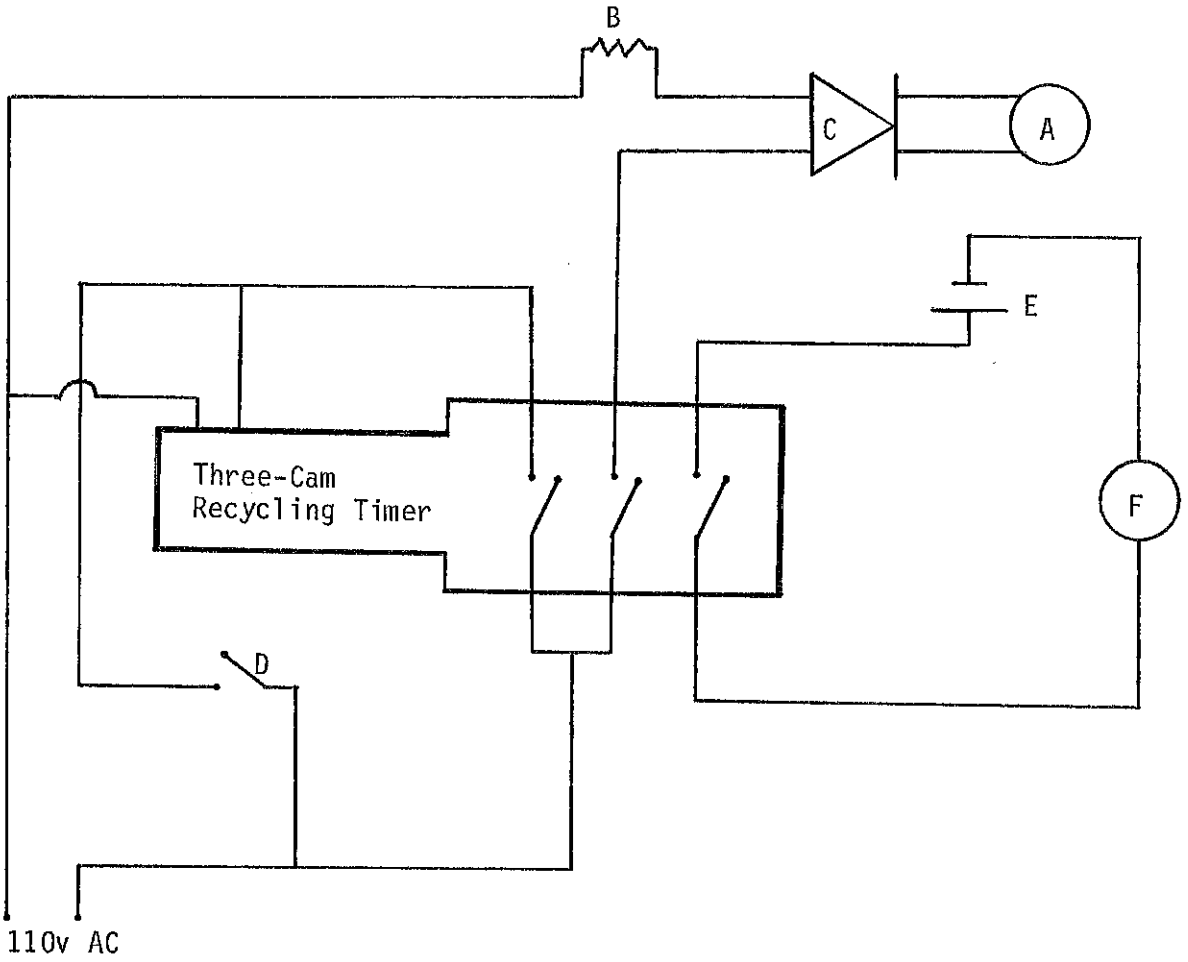


Figure 4 Shutter Device



A . . . Leedex rotary solenoid Model No. S-8210-027

B . . . Resistor 120 ohms

C . . . Rectifier for solenoid

D . . . Manual starting switch

E . . . Battery for signal device

F . . . Piezoelectric signal device

Figure 5

Shutter Control System

the motor cam as its switch closed. The motor cam switch would, therefore, enable the motor shaft to make one full rotation, after which it would stop automatically, unless the override switch was held down. The second cam controlled a switch in the solenoid circuit, allowing current to flow long enough to open the shutter for 0.43 seconds $\pm$ 0.01 seconds, as measured with a photoelectric cell and storage oscilloscope. The third cam operated a switch in an audio signal circuit that produced an audible tone lasting one second, timed to start approximately one second before the shutter opened. The tone is produced by a piezoelectric (solid state) signal device powered by a 1.5v AA cell.

To assist the subject in maintaining binocular fixation, a strip of wood about 2 cm wide was fabricated and painted white. The strip was hung directly in front of the concave mirror separating the mirror into halves. Half way down the wooden strip a piece of 2 cm square black photographic tape was attached to serve as a central fixation spot (Fig. 6). In order to keep subjects as steady as possible during the experimental trials the stock HVA chin rest was used with all subjects, along with a subject-monitored alignment guide. The alignment guide consists of a section of 2 mm thick wire with a small loop at the end. This device is located directly above the shutter on a transversely moveable piece of plywood, held down by four nails (Fig. 7). When directly centered in the subject's binocular field (it is adjusted for each subject), the wire will be seen in physiological diplopia and the two images will appear to be symmetrically placed on either side of the fixation spot. This alignment guide allows subjects to self-align themselves in the chin and

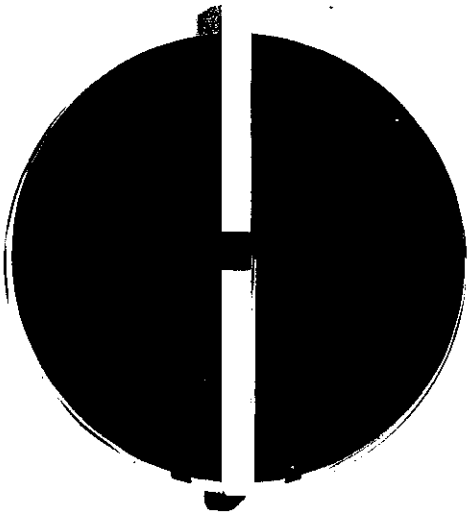


Figure 6 Mirror with Fixation Spot and White Poster Board Surround

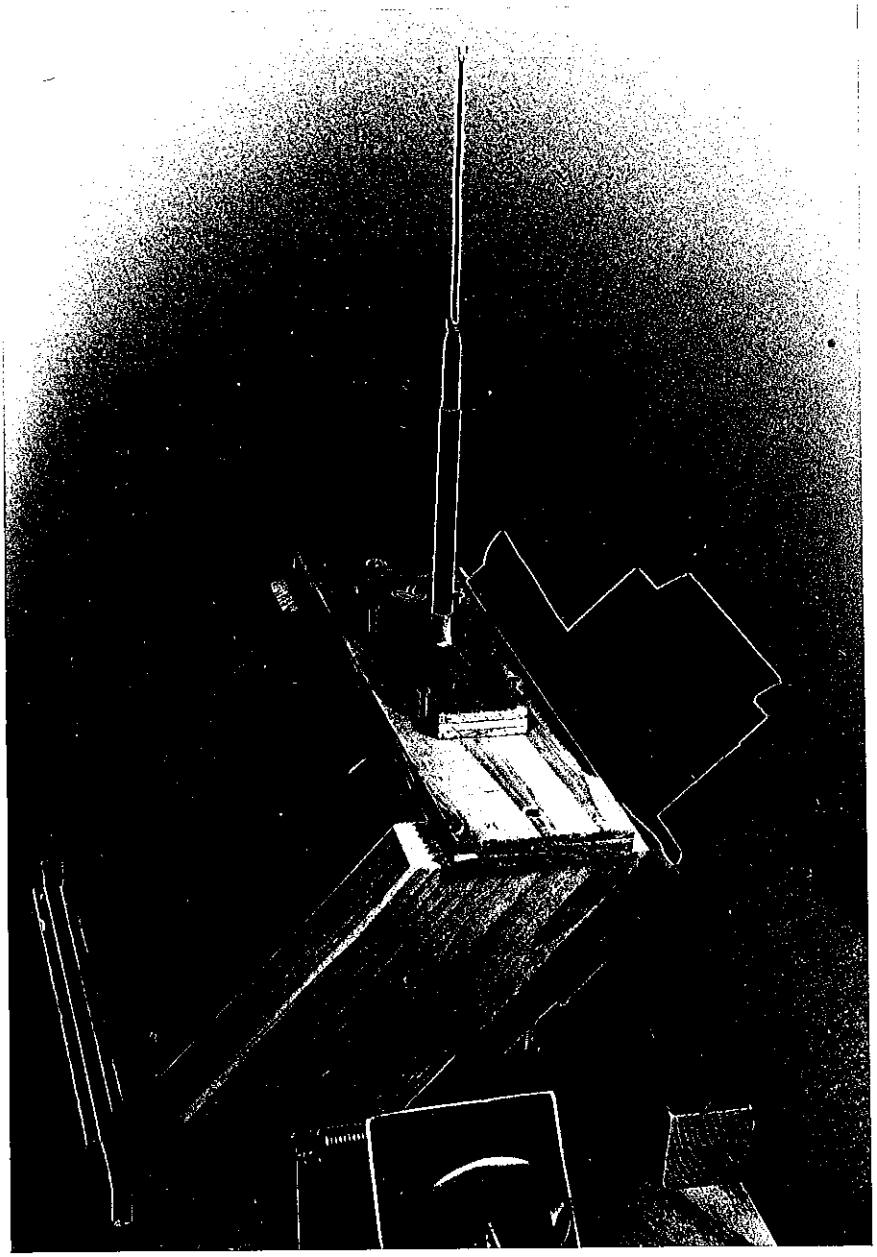


Figure 7 Subject-Monitored Alignment Guide

forehead rests after the initial alignment is done by the experimenter. Each time the subject starts a set of trials, the self-alignment procedure is used. Then the two test targets are exposed by lowering the shutter manually while luminous alignment circles (part of the HVA auxiliary lenses and apertures) are projected onto the subjects eyes. The aligning circles appear as 7 mm circular white areas, each surrounded by an orange ring so that if the central white area is not centered in the pupil the subject sees an orange hue at the edge of or possibly covering the entire field of view. This system allows the subject to make very precise adjustments in alignment to eliminate the orange hue and to be exactly aligned for the trials. During the trials the alignment circles are removed.

Since the HVA does not read out in monocular interpupillary distances (PD) and since monocular PD locations must be maintained for both pre and post calibrations, a millimeter scale was attached to the HVA next to the PD slider controls (Fig. 8). White tape was attached to the PD slider controls and a black mark was placed on the tape to allow reading of the millimeter scales to the nearest 0.25 mm.

To make a more uniform surround for the concave mirror, white poster board was attached to the mirror housing and a circular hole was cut in the cardboard corresponding to the opening for the mirror (Fig. 6).

To aid the subject's comfort during the trials, two platforms (one 10 cm the other 5 cm high) were available to elevate the subject's feet if desired.

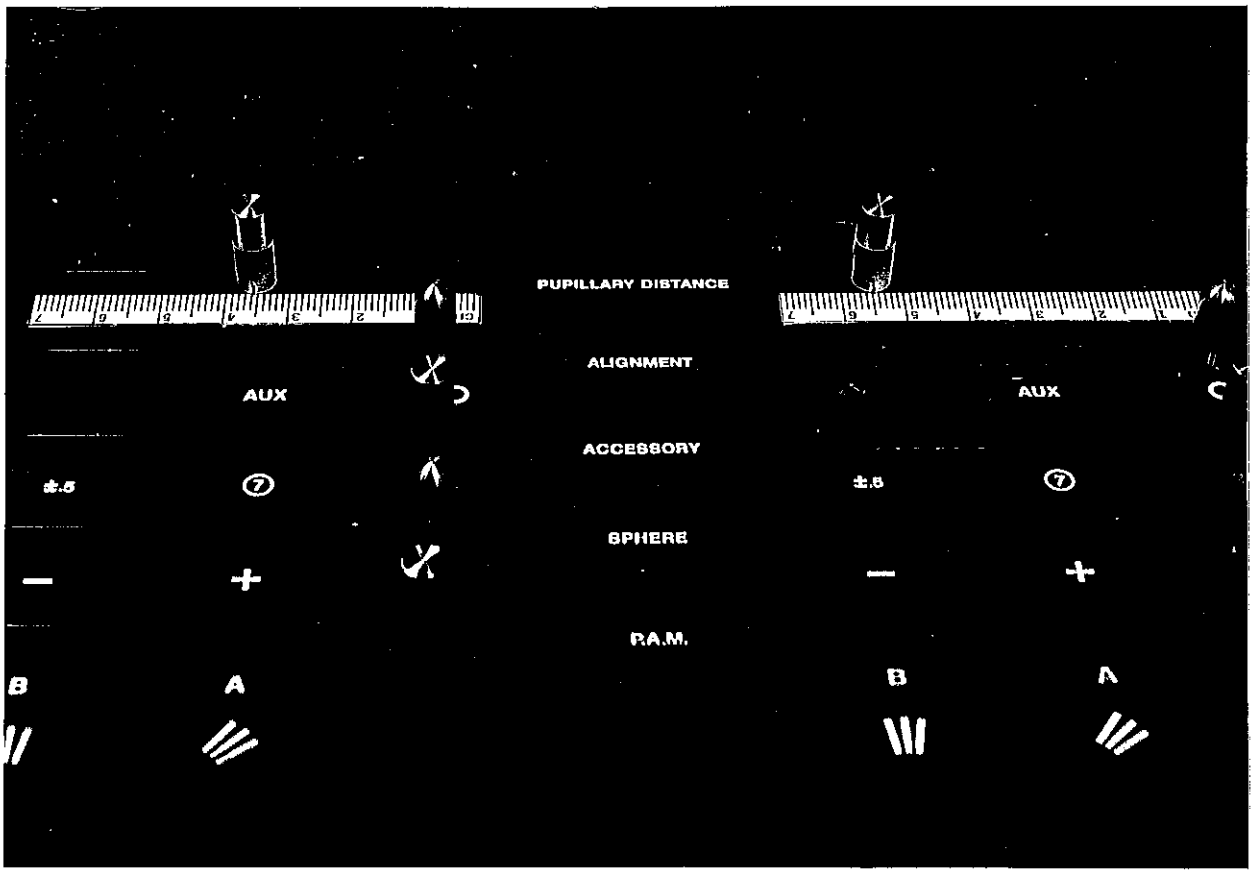


Figure 8 Millimeter PD Scales

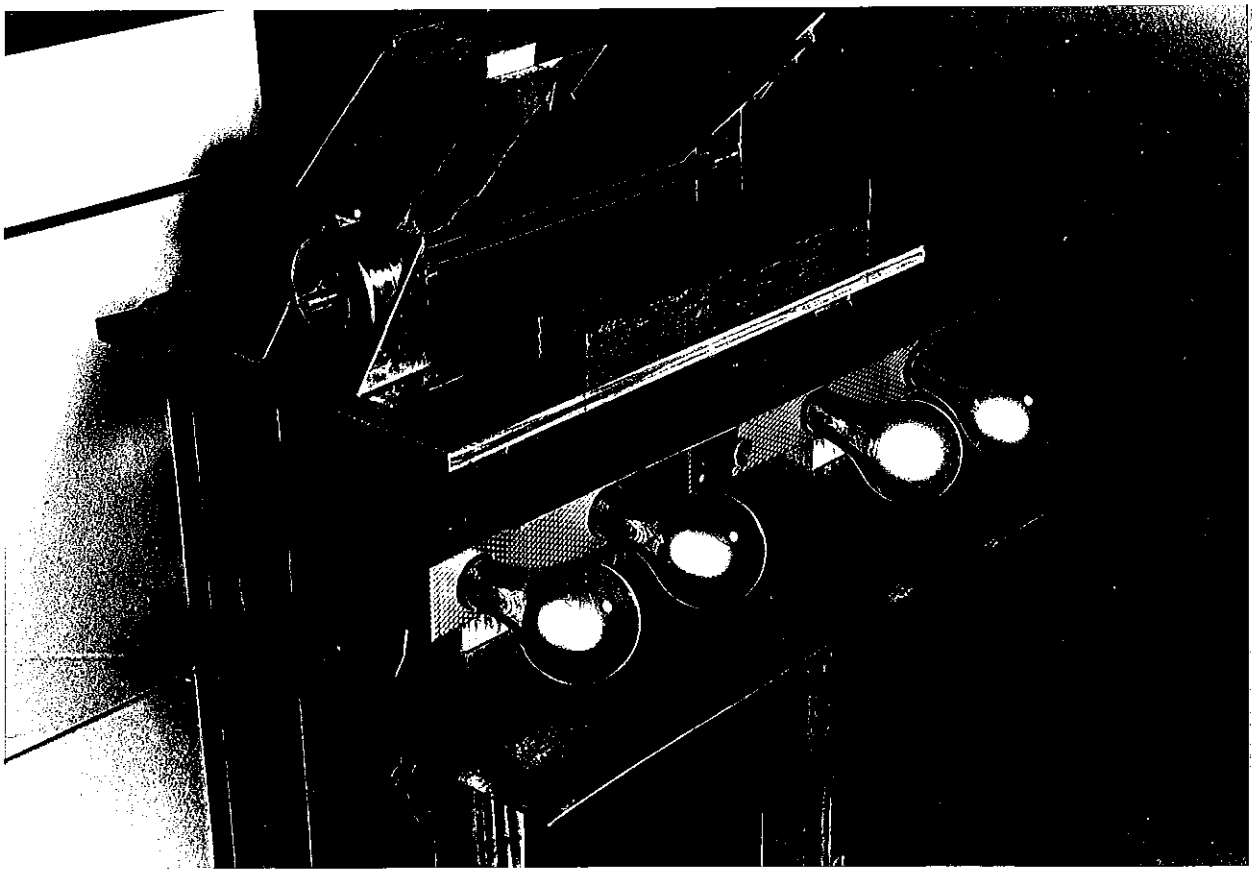


Figure 9 Light Bulbs and Reflectors Providing Adapting Luminance

The neutral density filters, with alignment marks, normally used for standard evaluations with the HVA, were not used for this study as the polarizing filters reduce the light level to the desired amount.

Surround illumination is provided by four 150 watt household light bulbs mounted in a movie light bar. The light bar is mounted on the front of the stand that holds the shutter device, and is aimed at the concave mirror. To produce more uniform illumination of the area surrounding the concave mirror, reflectors (galvanized sheet metal) were added above and below the row of lights (Fig. 9). To control the amount of illumination produced by the four bulbs a variable transformer is used between the lights and the 115v standard outlet. Three different surround luminance levels were used in this study. The three levels of surround luminance, hereafter referred to as High, Medium and Low, have the following photometric values: High = 87.5 cd/m^2, Medium = 44 cd/m^2, and Low = 23 cd/m^2. These values were monitored at various times during data collection and varied no more than 5 percent, an amount not considered significant. The medium level was first determined by subjective comparison of target brightness to surround luminance. One subject, with no abnormal visual functions, first determined the surround luminance that was the same brightness as the target circle set at the reference level (see Method for discussion of reference level). Next the surround luminance was slowly increased until the subject reported it was just noticeably brighter than the target and then the luminance was slowly decreased until the subject reported the surround just noticeably dimmer than the target. These three luminance levels were measured with the J16

photometer. The number of units (cd/m^2) between the just noticeable brighter and just noticeable dimmer was multiplied by two and that number of units was subtracted from the matching surround level. The number of units after subtraction became the medium luminance level. The high level is approximately double the medium luminance level and the low level is approximately half the medium level.

METHOD

Prior to the experimental procedure the following information was obtained from each subject: name, unaided visual acuity, spectacle correction, aided visual acuity, date of habitual prescription, percent of waking hours prescription is worn, date of birth, stereothreshold in arcseconds (with habitual Rx) using the Randot Stereotest (Stereo Optical Co., Inc.), color perception using the American Optical 14 plate Pseudoisochromatic test, monocular push-up amplitude of accommodation, subjective refraction with acuities if previous acuity tests did not show at least 20/25 in each eye, distance horizontal and vertical phorias using the HVA, ocular media status, internal ocular health and monocular PD's measured with the PD scales added to the HVA by the investigator.

After the pre-examination, and before the experimental procedure, the HVA was converted to its experimental configuration as described in the "MATERIALS" section of this dissertation. The projector bulbs were powered by the external power source at least two hours before starting a trial to allow both bulbs to stabilize their light outputs. A Tektronix J-16 Photometer with J6511 illuminance probe was used for calibration of light levels incident on the test eyes. Due to inhomogeneties of the projected light after passing through crossed polarizing filters and three "cold", front surface, reflecting mirrors the J6511 illuminance probe was modified to evaluate only a 6 mm bundle of light. This same bundle of light was used during the experimental trial to enter the given pupil. The auxiliary ring for the illuminance probe was fitted with a 4 cm round piece of sheet aluminium. The aluminium sheet was drilled and tapered to a 6 mm aperture. The only light entering the

illuminance probe was through the 6 mm aperture. To aid constant placement of the illuminance probe for both pre and post calibrations a piece of masking tape was placed on the side of the probe that faced the vertex distance light of the HVA. A black line was drawn on the tape at a point corresponding to the convex surface of the probe (Fig. 10). This allowed repeatable placement of the probe at the same location as the cornea of each subject. To further control alignment of the probe during calibration, the 7 mm apertures (standard HVA auxiliary apertures) were used. The 7 mm apertures allowed repeatable placement of the probe at the same location the subject's pupils would occupy during the experimental trials.

Pre-calibration was done without any room illumination and stray light from the projector bulbs was reduced with a cardboard cover that fit over the control panel (Fig. 11). When the probe was properly aligned, and the photometer zeroed, the relative illuminances were measured for both channels at the following polarizer settings: 0 to 20 degrees in 5 degree steps and 22 1/2 to 50 degrees in 2 1/2 degree steps. To further evaluate the consistency of the outputs, second (retrace) measures were made at 40, 30, 20 and 0 degrees. When the measures were completed for both right and left channels the room lights were turned on, the cardboard cover was removed from the console, the probe was moved out of the subject's way, and the HVA chin rest was secured in place. Since different PD settings produced different light levels at the same polarizer settings, it was necessary to select the proper reference level setting for the right and left channels. To provide consistency for all subjects, the setting that yielded a

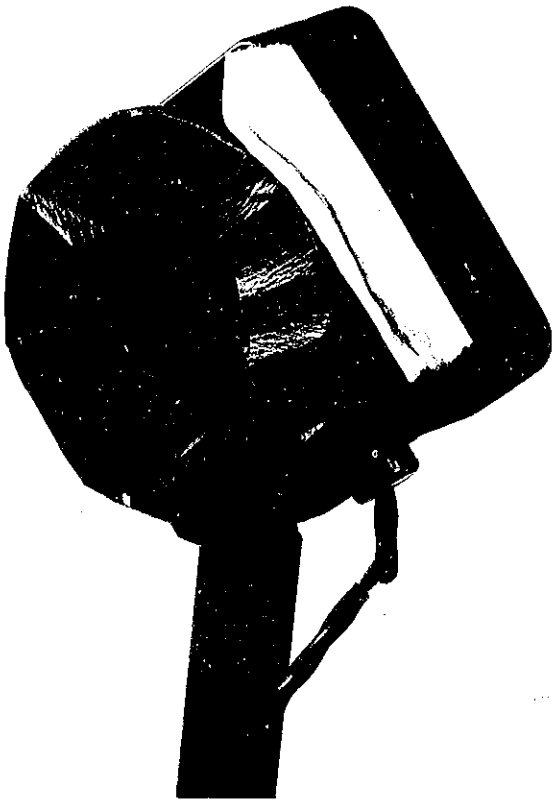


Figure 10 Illuminance Probe with Alignment Mark

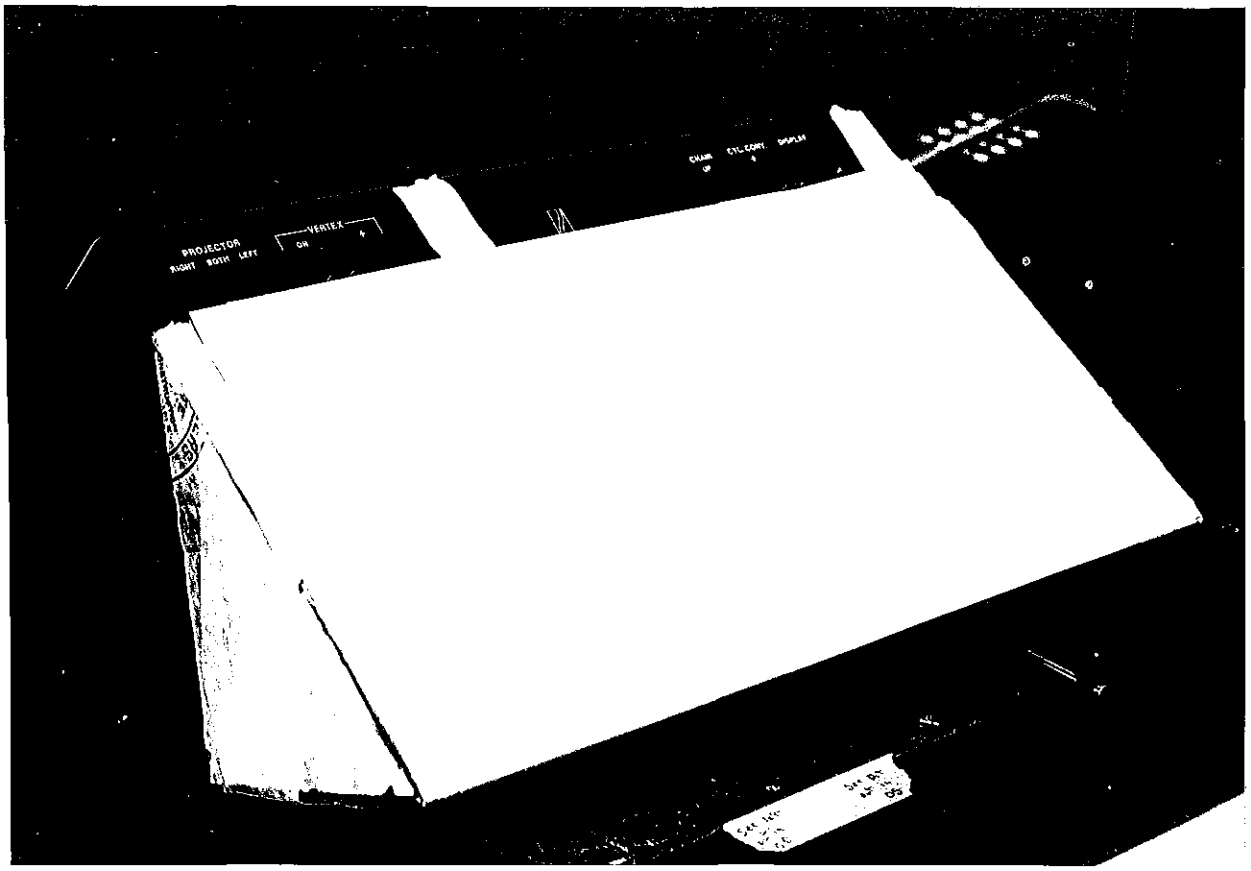


Figure 11 Control Panel with Cardboard Cover

relative photometric level close to 110 light units was used as the reference. This setting may not have been the same degree location for both eyes because of unequal filtering properties of the two polarizing filters. The 110 level was chosen to provide sufficient light levels above and below the reference setting to measure significant mismatches without the use of neutral density filters over the polarizers.

On arriving, the subject was seated at the HVA and given the following instructions:

"After alignment in the apparatus you will refrain, as much as possible, from moving your head. There will be several rest periods during the experimental session, but if you feel you must move your head, notify the experimenter. You will be requested not to talk during the trials as this will change your eye position. You will communicate with hand signals during the procedure. When the experimenter says 'ready begin', keep your eyes fixed on the black square on the piece of wood separating the mirror into two halves. In a few seconds you will hear an audible tone that will last for one second. Approximately one second after the tone stops a shutter will open momentarily, and two circles of light will be visible in the mirror, one on each side of the black square. The two circles will not be perfectly round in that the portion closest to the black square will be slightly flattened. The two circles will be visible for only 1/2 second. Based on this brief exposure of the two circles you are to determine which of the circles is brighter. Since you have less than a second to observe the circles you will not have time to look at each individually, so be sure to keep looking at the black square in the

middle of the mirror. After each exposure to the lighted circles you will relay your observation to the experimenter by the following hand signals: if the circle on your left is brighter, raise your left hand, if the circle on your right appears brighter, raise your right hand, and if you cannot tell any difference in the brightness of the two circles raise both of your hands. You are not to guess. If you are unsure which circle is brighter raise both hands to indicate no difference detected. The procedure will begin with a large difference in brightness between the two circles and gradually, with each exposure, the difference will decrease until no difference is detected. The difference will then keep changing until you see, and communicate, a reversal in brightness. The experimenter will then continue to change the illumination until a large difference between the two circles is present. He will then reverse the difference, slowly going back to the settings existing at the start of the procedure. This will complete one entire cycle in the experimental procedure. You will be given a chance to rest after three cycles; sooner if desired. At this time, if you have any questions please address them to the experimenter. If not, your alignment will be completed and one cycle will be run to familiarize you with the procedure. Please use hand signals according to the instructions."

The room lights were then turned off and sufficient light provided from the four 150 watt bulbs for the subject to see and fixate the black square. The shutter was held open with an aluminium clip, and the 7 mm apertures moved into place. Next the subject was adjusted up, down, right and left until the 7 mm apertures were centered in each pupil. The chin rest was adjusted

for patient comfort and to ensure that precise alignment of apertures and pupils were maintained. The self alignment guide was slowly slid into view, and the subject was told to indicate when the two wire images appeared symmetrically placed on either side of the black square. Adjustment was then made so the top of the alignment guide was level with the black square. When properly aligned, the subject should not see any orange hue from the 7 mm apertures. If any orange was visible the subject made slight adjustments in head position to achieve a more precise alignment and, if necessary, the experimenter would alter the self alignment guide to conform to the new position.

Once aligned the shutter was closed, the surround luminance raised to the predetermined level for the first set of six cycles, and the subject told that the familiarization trial would begin.

At the completion of the familiarization trial, the subject was allowed to sit back out of the chin rest and asked if there were any questions. When rested, the subject was instructed to return to the chin and forehead rest, and to use the self alignment guide as before. Next, the pupil diameter was measured with a "pupil size" matching gauge and the 7 mm apertures were moved into place. The shutter was opened manually while the polarizing filters were both adjusted to maximum brightness. The subject made fine adjustments, if necessary, to eliminate the orange hue, the shutter was returned to its 45 degree (closed) position and the 7 mm apertures were removed. The reference illuminance level of the appropriate channel was set and the other channel was set to either the brightest or dimmest setting according to the random order schedule (Appendix A). The start button was held down and

the procedure was begun. After the subject's responses to each exposure the experimenter re-set the polarizer of the non-reference channel. The polarizer setting was altered after each exposure by an amount producing an approximately 10 percent change in light output. These changes were continued until the polarizer's degree setting reached the opposite end of the 0 to 50 degree scale. When the subject responded with two consecutive reversal responses, the degree setting of the first reversal was recorded as one endpoint of six pieces of data using that channel as reference along with the preset surround luminance. After reaching the other extreme on the scale the order of presentation was reversed, and the procedure was repeated until a second endpoint was found, completing the cycle. After completing three cycles (six pieces of data) the subject was allowed to rest, as needed. The subsequent test was conducted with the same surround luminance but with the opposite channel serving as reference. After six more pieces of data were collected the pupils were measured again, before the surround luminance level was re-set for twelve more pieces of data taken exactly as described above. The surround luminance was then changed for the third, and last time, and the final twelve pieces of data were obtained for that luminance level. This psychophysical procedure (method of limits[7]) was used to determine an illumination level in one eye that produces a matching brightness in the opposite eye (reference eye) by averaging the three ascending with the three descending reversal points. When all thirty-six reversal points (twelve for each of the three surround luminance levels) and six pupil measures had been recorded the subject was given an opportunity to ask questions and then excused. Post-trial

calibration readings were taken exactly as described for the pre-trial calibration except that only those degree settings recorded as reversal points during the experimental procedure were measured with the illuminance probe and photometer.

SUBJECTS

Thirty subjects were utilized for this study, fifteen in each of two groups. The subjects were selected by stereo test screening of optometry students, staff and faculty of Pacific University College of Optometry and Pacific University College of Optometry clinic patients.

The experimental group was selected according to the following criteria: visual acuity correctable to at least 20/25 (0.8) in each eye, stereothreshold with refractive error corrected, 50 to 100 arcseconds,* normal color perception (each eye tested separately), Donder's (push-up) nearpoints of accommodation (monocular) differing by no more than two diopters between the two eyes, distance horizontal phoria between 4 exophoria and 4 esophoria, vertical phoria of 1/2 prism diopter or less,** no active or inactive ocular pathology and clear media in both eyes. The control group met the same criteria as the experimental group but had stereothresholds of 40 arcseconds or less, which is considered average.[8]

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* This range was the criterion used for screening purposes, but the actual range of thresholds was 50 to 70 arcseconds.

** All subjects met the criteria except for one in the control group (#2) who had approximately 1 prism diopters of vertical phoria.

TREATMENT OF DATA

Each of the thirty-six reversal points (in degrees), for a given subject, was converted to its relative illuminance value by referring to, and averaging, the appropriate pre and post trial calibration values. Next, each group of six relative illuminance values was averaged and the relative percent differences (RPD) between right and left illuminances (required for a brightness match) were calculated using the formula $\{(x-y)/(x+y)\}$ (200). This relation yields a value for RPD that does not depend on either the right (x) or left (y) matching illuminance as a reference (base), because the denominator is the arithmetic mean of the two values; i.e., the above formula is a simplification of $\{(x-y)/(\frac{x+y}{2})\}$ (100). This reduced data is found on each CMCB Data Sheet and tabulated in Table I where plus signs indicate the need for higher illuminance in the right eye (minus signs the left eye) for a brightness match.

Since each subject was tested for asymmetry at three different adapting luminance levels, the data analysis probed the effects of successive experimental manipulations (the three luminance levels) on right to left illuminance ratios required for brightness matching. The statistical procedure used for this purpose was adapted from a "Treatment by Subjects" (repeated measures) design.[9] This design is also known as a "Single Factor Analysis of Variance" (code name SANVAR), on file at the Pacific University College of Optometry Computer Center. The experimental and control groups were evaluated separately by SANVAR using the three RPD values, one for each adapting luminance level, as the repeated measures for each subject.

TABLE I
DATA FROM THE EXPERIMENTAL GROUP

	A HIGH	B MED	C LOW	D AVER
SUBJECT				
1	+17.8	+12.5	+19.9	+16.7
2	-31.0	-27.0	-42.2	-33.4
3	-14.8	-10.8	+08.8	-05.6
4	-24.3	-33.6	-26.5	-28.1
5	+19.1	+24.1	+05.0	+16.1
6	-15.0	-12.6	-09.0	-12.2
7	+07.9	-11.9	-24.2	-09.7
8	+00.4	-05.9	-09.6	-05.0
9	-08.0	-14.3	-16.9	-13.1
10	+10.6	+07.7	+09.0	+09.1
11	-19.6	-18.8	+00.8	-12.5
12	+09.6	+16.1	+21.7	+15.8
13	+01.6	-02.3	-06.0	-02.3
14	+04.4	+08.8	+01.9	+05.0
15	+21.4	+13.0	+17.1	+17.2
AVER	13.7	14.6	14.6	13.5
S.D.	8.7	8.3	11.1	8.5

DATA FROM THE CONTROL GROUP

	HIGH	MED	LOW	AVER
SUBJECT				
1	+06.5	+01.3	+03.0	+03.6
2	+00.5	-02.8	+00.5	-00.6
3	+01.8	+02.6	+02.6	+02.3
4	-00.5	-00.9	00.0	-00.5
5	+04.6	+05.5	+05.5	+05.2
6	-03.0	+03.7	-05.2	-02.0
7	00.0	+00.5	-00.9	-00.1
8	-02.8	+00.5	-03.5	-02.0
9	-11.5	-02.0	-38.7	-17.4
10	-01.4	-02.0	-06.5	-03.3
11	-04.6	-05.1	-04.6	-04.8
12	-00.9	-04.6	-05.9	-03.8
13	-00.9	-06.2	-07.6	-04.9
14	-00.9	-05.2	-01.4	-02.5
15	-03.5	-03.6	-07.1	-04.8
AVER	2.9	3.1	6.2	3.9
S.D.	3.0	1.9	9.3	4.1
	t=4.54	t=5.23	t=2.25	t=3.94
LEVEL OF SIGNIF.	0.001	0.001	0.05	0.001

AVERAGE PERCENT MISMATCHES FOR THE EXPERIMENTAL AND CONTROL GROUPS AT EACH OF THE THREE ADAPTING LUMINANCES (COLUMNS A,B,&C). COLUMN D SHOWS PERCENT MISMATCHES AVERAGED ACROSS THE THREE LUMINANCES FOR EACH SUBJECT. ALSO INCLUDED ARE t VALUES AND LEVELS OF SIGNIFICANCE RESULTING FROM A COMPARISON BETWEEN EXPERIMENTAL AND CONTROL GROUPS COLUMN BY COLUMN.

The SANVAR calculation produces an F ratio which is used to estimate the probability of random occurrence of the experimental results. Results are considered significant if there is less than one percent probability of obtaining a calculated F by random factors alone ($P<0.01$).[10] However, if the probability is between one and five percent ($0.01<P<0.05$) the results are considered probably significant.[11] Significance, in the present context, means nonrandom variation (instability between treatments) in matching illuminance ratios as adapting (surround) luminance changes over an approximately 0.6 log unit range (a factor of four times).

Since the only known difference, prior to the experiment, between the control and experimental groups was the stereothreshold, a supplemental analysis probed the differences in percent mismatch between these two groups. Four "t" tests (for independent measures)[9] were used to compare the experimental (E) with the control (C) group, (Appendix B). The two groups were compared column by column; high adapting luminance values versus high; medium versus medium; low versus low, and, finally, overall average percent mismatches (across the three adapting luminances) for the E versus C groups. As with the F ratio, results are considered significant if there is less than one percent probability of obtaining a calculated "t" value by random factors alone ($P<0.01$).[10] However, if the probability is between one and five percent ($0.01<P<0.05$) the results are considered probably significant.[11] Significance, in this context, means that the E and C group values come from different populations; e.g., when the level of significance is 0.01, there is only a one percent chance of obtaining the observed differences between E and C groups by random factors alone.

RESULTS

The average mismatches across the three illuminances were 13.5 percent for the E group (S.D. = 8.5), and 3.9 percent for the C group (S.D.=4.1). SANVAR analyses of the data from each group yielded the following:

CONTROL GROUP: $F = 2.00$

EXPERIMENTAL GROUP: $F = 0.10$

Both F values would occur more often than 10 percent of the time through random factors alone ($P>0.10$).* It is, thus, concluded that the percent mismatches in both control and experimental groups are stable over the three adapting luminance levels.

The supplemental analysis performed with the "t" test (Appendix B) yielded the following results:

High Luminance Mismatch	$t = 4.54$	($P<0.001$)
Medium Luminance Mismatch	$t = 5.23$	($P<0.001$)
Low Luminance Mismatch	$t = 2.25$	($P<0.05$)
Mean Mismatch per Subject	$t = 3.94$	($P<0.001$)

The "Low" luminance "t" value is significant between the 0.05 and 0.02 level, indicating that the probability of the calculated "t" value occurring by chance is between two and five times in one hundred. The remaining "t" values are statistically significant at the 0.001 level, indicating the probability of these "t" values occurring by chance is less than one time in a thousand. It is thus concluded that the percent mismatch is significantly larger in the experimental group than in the control group, and the amount of the difference

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* Critical F ratio for df_1/df_2 of 2/28 is 2.50 at the ten percent level of significance.

averages about 10 percent. A further indication that the E and C groups belong to separate populations is the pronounced difference between the standard deviations of the two groups (8.5 vs 4.1, Col D).

The evaluation of a possible relation between eye dominance and the eye requiring higher illuminance for a brightness match gave the following results:

EXPERIMENTAL GROUP

Dominant eye required higher illuminance . . . . . 7 subjects

Non-dominant eye required higher illuminance . . . . 8 subjects

CONTROL GROUP

Dominant eye required higher illuminance . . . . . 6 subjects

Non-dominant eye required higher illuminance . . . . 9 subjects

Thus, there is no clear relation between eye dominance and requirement for higher illuminance. This tentative conclusion is based on the findings for this particular group of subjects and the "Hole-in-the-card" test,[12] used in this study, to determine eye dominance.

DISCUSSION AND CONCLUSIONS

Based on the results of the SANVAR analysis, it is concluded that there is no significant variation in matching illuminance ratios with changes in adapting luminance in either the E or C group over the range of luminances used in this study. Thus, the null hypothesis (H_o) is accepted. The implication from this result is that the mismatches will be found to be stable over a wide range of photopic luminances.

Based on the results of the "t" test (independent measures), the E and C groups differed from each other at levels of significance ranging from the 0.001 to the 0.05 level, depending upon the level of adapting luminance. Moreover, it is noteworthy that the average values across all three luminances (Col. D in Table I) showed a highly significant difference between the E and C groups ($P<0.001$).

In addition, this study revealed similar results for normal binocular subjects, save one, to those found in Corcoran's study, mentioned in the INTRODUCTION. Furthermore, individuals with high stereothreshold (50-70 arcseconds) demonstrated, in general, higher percent mismatches for tasks employed in this investigation, compared with subjects having normal stereothresholds (20-40 arcseconds). Finally, the dispersions of data were higher for both E and C groups under the low luminance condition (Col. C) when compared to either the high or medium luminance conditions (Cols. A or B, Table I).

FUTURE CONSIDERATIONS

Although it cannot be inferred from these results that higher mismatches caused reduced stereoacuity, it is a possible topic for future investigation. If a causal relationship could be established it is conceivable that remediation of the mismatch through the use of a neutral density filter over the eye requiring less illuminance for the brightness match, could possibly improve the stereoacuity. The use of a neutral density filter would seem to be the logical choice of remediation as the mismatch is relatively stable even with change in adapting luminance (at least over the range employed in this experiment).

Since reduced stereoacuity is a subtle binocular condition, future study could evaluate the implication that other anomalous conditions (amblyopia, strabismus, etc.) might be associated with a similar brightness mismatch. In this regard one report in the literature describes a successful treatment of amblyopia with crossed polarizing filters over the non-amblyopic eye.[13]

If evaluation of relative monocular contributions to brightness is to become a clinically useful tool, improvements in the means of determining the mismatch will have to be made. Due to its complexity and duration (approximately one and one half hours), the present procedure does not lend itself to general clinical use, especially with young children or those with reduced mental capacity. It would be a great advantage if an objective test procedure, such as Visual Evoked Response (VER) latency or amplitude, could be used to evaluate the amount of mismatch or amount of filtering necessary to eliminate a mismatch. This might be possible by measuring the

VER, using neutral density filters of different density, over one eye and then over the other.

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APPENDIX A

RANDOM ORDER OF PRESENTATIONS

Surround Light Level	First Reference Channel	First Direction of Variability	Subject Number
H M L	Left	Descending	1
M L H	Right	Ascending	2
L H M	Left	Ascending	3
H L M	Right	Descending	4
M H L	Left	Descending	5
L M H	Right	Ascending	6
H M L	Right	Descending	7
M L H	Left	Ascending	8
L H M	Right	Ascending	9
H L M	Left	Descending	10
M H L	Right	Descending	11
L M H	Left	Ascending	12
H M L	Left	Descending	13
M L H	Right	Ascending	14
L H M	Left	Ascending	15

APPENDIX B

"t" TEST FOR INDEPENDENT MEASURES

The following formula is adapted from Section 1.5, Computational Handbook of Statistics, by Bruning and Kintz (see References).

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left[\frac{S_1^2 (N_1-1) + S_2^2 (N_2-1)}{N_1 + N_2 - 2}\right] \cdot \left[\frac{1}{N_1} + \frac{1}{N_2}\right]}}$$

Where: t = t value

$\bar{X}_1$ = mean of first group

$\bar{X}_2$ = mean of second group

S_1 = variance of first group

S_2 = variance of second group

N_1 = number of subjects in first group

N_2 = number of subjects in second group

APPENDIX C

CMCB DATA SHEETS

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40a

LAMPS ON AT 12:00 pm DATE 26 Feb 83

START TIME 1:20 pm CALIBRATIONS FINISH TIME 2:40 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	214 215	202	187	169	149 150	140	130	118	108 108	98	88	78	69 69	60	52	43	36
Post trial	211	198	184	166	147 148	137	128	117	107 107	97	87	76	68	___	___	___	___

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	230 231	217	197	180	156 156	146	135	126	111 112	101	92	81	67 68	58	49	41	34
Post trial	231 231	___	198	___	158 158	147	137	126	114 114	103	93	82	___	___	___	___	___

#1 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 29 OS 49.5 HVA 64 mm

Rx OD -1.00 -1.75 x 025 % Worn

OS -1.25 -1.50 x 140 100%

PUPIL SIZE START HIGH 5.5 mm ou MEDIUM 6 mm ou LOW 7 mm ou

FINISH 5.5 mm ou 6 mm ou 7 mm ou

OD REFERENCE = 27½° = 118 OS REFERENCE = 30° = 115

	HIGH	MEDIUM	LOW
ASCENDING	25° = 136	25° = 136	25° = 136
	27½° = 126	27½° = 126	27½° = 126
	27½° = 126	27½° = 126	27½° = 126
DESCENDING	35° = 93	35° = 93	37½° = 82
	35° = 93	35° = 93	37½° = 82
	37½° = 82	35° = 93	37½° = 82
AVERAGE OS	109	111	106
AVERAGE OD / AVERAGE OS	7.93	6.11	10.71

	HIGH	MEDIUM	LOW
ASCENDING	10° = 185	20° = 149	10° = 185
	5° = 200	15° = 168	10° = 185
	10° = 185	20° = 149	15° = 168
DESCENDING	27½° = 118	25° = 129	25° = 129
	30° = 108	27½° = 118	22½° = 139
	27½° = 118	27½° = 118	27½° = 118
AVERAGE OD	152	139	154
AVERAGE OD / AVERAGE OS	27.72	18.9	29.0

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+17.8%	+12.5%	+19.9%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	___	___	___

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40b

LAMPS ON AT 8.50 am DATE 17 Feb 83

START TIME 12:48 pm CALIBRATIONS FINISH TIME 14:25 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	209	195	181	163	145 (146)	136	126	116	106 (106)	96	85	77	67 (67)	59	51	42	35
Post trial	210				147 (147)	137	127	116	107 (107)	96	86	77	68 (68)	60	51		

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	234	219	202	182	160 (161)	150	139	127	115 (115)	105	94	82	72 (72)	61	52	43	34
Post trial	237	221	205	185	162 (162)	152	142	130	117 (117)								

#2 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 26 OS 46.5 HVA 63 mm

Rx OD −1.62 sph % Worn

OS −0.87 sph 100 %

PUPIL SIZE HIGH 4 mm ou MEDIUM 4 mm ou LOW 5 mm ou

OD REFERENCE = 27½° = 116

OS REFERENCE = 30° = 116

	OD HIGH	OD MEDIUM	OD LOW	OS HIGH	OS MEDIUM	OS LOW
ASCENDING	15° = 184	20° = 161	15° = 184	30° = 107	30° = 107	40° = 68
	20° = 161	15° = 184	10° = 204	30° = 107	30° = 107	35° = 86
	20° = 161	15° = 184	15° = 184	27½° = 116	27½° = 116	37½° = 77
DESCENDING	22½° = 151	25° = 141	30° = 116	45° = 51	35° = 86	45° = 51
	25° = 141	20° = 161	27½° = 129	42.5° = 60	37.5° = 77	45° = 51
	25° = 141	25° = 141	30° = 116	42.5° = 60	37.5° = 77	42.5° = 60
AVERAGE	OS 157	162	156	OD 84	95	66

AVERAGE OD / AVERAGE OS: −30.04 −33.09 −29.41

AVERAGE OD / AVERAGE OS: −32.0 −19.9 −54.95

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−31.0%	−27.0%	−42.2%
AVERAGE DIFFERENCE IN LOG_{10} UNITS			

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40c

LAMPS ON AT 10:45 am DATE 1 May 83

START TIME 12:45 pm CALIBRATIONS FINISH TIME 2:10 pm

Pre-trial Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
200 201	191	175	159	140 141	132	123	112	102 103	93	84	75	66 66	59	50	43	36
Post trial																
196 195		172		140 140	131	122	111	102 102	92	83	75	67				

Pre-trial Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
201 200	187	172	155	137 137	128	119	109	99 99	89	81	72	62 62	53	45	38	31
Post trial																
196		170	157	134 135	126	117	106	97 97	87	79	71					

#3 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 29 OS 41 HVA 70mm

Rx OD none % Worn

OS ____ %

PUPIL SIZE HIGH MEDIUM LOW

START 5 mm on 6 mm on 7 mm on

FINISH 4½ mm on 5½ mm on 7 mm on

OD REFERENCE = 30° = 102

OS REFERENCE = 30° = 98

OD HIGH	OD MEDIUM	OD LOW	OS HIGH	OS MEDIUM	OS LOW
15° = 156	22½° = 127	30° = 98	22½° = 132	30° = 102	25° = 123
10° = 171	20° = 136	27½° = 108	30° = 102	25° = 123	22½° = 132
15° = 156	15° = 166	27½° = 108	27½° = 112	25° = 123	25° = 123
30° = 98	30° = 98	37½° = 72	40° = 66	32½° = 75	32½° = 93
27½° = 108	22½° = 127	35° = 80	37½° = 75	37½° = 75	37½° = 75
27½° = 108	30° = 98	35° = 80	35° = 84	37½° = 75	37½° = 75
AVERAGE OS 133	124	91	AVERAGE OD 95	96	104
OD / AVERAGE OS −26.38	−19.47	11.4	AVERAGE OD / OS −3.11%	−2.06%	5.94%

ASCENDING / DESCENDING

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−14.8	−10.8	+8.8
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40d

LAMPS ON AT 11:50 am DATE 2 Mar 83

START TIME 1:45 pm CALIBRATIONS FINISH TIME 3:05 pm

Pre-trial Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
				145				105				67				
206	195	181	164	144	134	125	114	104	93	84	75	66	58	49	42	34
Post trial				140				101				65				
202	___	___	___	141	130	121	111	101	91	82	74	65	57	___	___	___

Pre-trial Left Channel

				154				110				69				
226	211	193	175	153	144	133	122	110	100	89	79	68	58	49	42	34
114 Post trial				150												
220	208	189	172	156	141	131	120	109	___	___	___	___	___	___	___	___

#4 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 27 3/4 OS 50 3/4 HVA 62mm

Rx OD -.75 -.75 x 008

OS -.75 -.50 x 002

Worn during Trial, % Worn 50%

PUPIL SIZE

	HIGH	MEDIUM	LOW
START	4 mm on	5 mm on	5.5 mm on
FINISH	4 mm on	5 mm on	5 mm on

OD REFERENCE = 27½° = 113

OS REFERENCE = 30° = 110

	HIGH	MEDIUM	LOW
ASCENDING	5° = 210	5° = 210	10° = 191
	5° = 210	5° = 210	10° = 191
	10° = 191	10° = 191	10° = 191
DESCENDING	30° = 110	25° = 132	25° = 132
	27½° = 121	25° = 132	30° = 110
	27½° = 121	25° = 132	27½° = 121
AVERAGE OS	161	168	156

	HIGH	MEDIUM	LOW
ASCENDING	27½° = 113	30° = 103	30° = 103
	25° = 123	30° = 103	30° = 103
	27½° = 113	30° = 103	27½° = 113
DESCENDING	37½° = 75	40° = 66	37½° = 75
	37½° = 75	42½° = 58	40° = 66
	37½° = 75	40° = 66	37½° = 75
AVERAGE OD	96	83	89

	HIGH	MEDIUM	LOW
OD / AVERAGE OS	-35.04	-39.15	-31.97
AVERAGE OD / OS	-13.59	-27.98	-21.1

AVERAGE PERCENT DIFFERENCE - 24.3% -33.6% -26.5%

AVERAGE DIFFERENCE IN LOG_{10} UNITS ___ ___ ___

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40e

LAMPS ON AT 1:45 pm DATE 3 May 83

START TIME 4:45 pm CALIBRATIONS FINISH TIME 6:20 pm

Pre-trial Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
221	209	193	174	155 (154)	144	134	123	112	101	90	81	71	63	53	45	37
Post trial																
216				151				109								
217				151	141	130	119	109	99	88						

Pre-trial Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
214				146				106				66				
215	201	184	166	147	138	128	117	105	96	87	76	67	57	49	40	33
Post trial																
212				149				108								
217				149		130	119	108	98	88	78	68				

#5 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 26+ OS 39+ HVA 69 mm

Rx OD none % Worn

OS ____ %

PUPIL SIZE START: HIGH 3 mm on, MEDIUM 3½ mm on, LOW 4½ mm on

FINISH: HIGH 3 mm on, MEDIUM 4 mm on, LOW 4 mm on

OD REFERENCE = 30° = 111

OS REFERENCE = 30° = 107

	HIGH		MEDIUM		LOW	
DESCENDING	25°	= 129	30°	= 107	27½°	= 118
	30°	= 107	30°	= 107	25°	= 129
	32½°	= 97	32½°	= 97	25°	= 129
	32½	= 77	35°	= 88	35°	= 88
	37½	= 77	37½°	= 77	35°	= 88
	40°	= 67	37½	= 77	37°	= 88
AVERAGE OS		92		92		107

	HIGH		MEDIUM		LOW	
ASCENDING	20°	= 153	20°	= 153	25°	= 132
	20°	= 153	20°	= 153	22½	= 143
	22½°	= 143	20°	= 153	25°	= 132
	30°	= 111	22½°	= 143	32½	= 100
	30°	= 111	25°	= 132	35°	= 89
	30°	= 111	25°	= 132	35°	= 89
AVERAGE OD		130		144		114

	HIGH	MEDIUM	LOW
OD / AVERAGE OS	18.72	18.72	3.67
AVERAGE OD / OS	19.41	29.48	6.33

AVERAGE PERCENT DIFFERENCE: HIGH +19.1% MEDIUM +24.1% LOW +5.0%

AVERAGE DIFFERENCE IN LOG_{10} UNITS: HIGH ____ MEDIUM ____ LOW ____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40f

LAMPS ON AT 12:00 pm DATE 6 Mar 83

START TIME 2:30 pm CALIBRATIONS FINISH TIME 3:45 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	213				148				108				68				
	214	201	186	168	149	140	130	119	110	99	88	78	69	60	52	43	36
Post trial	212								109								
	212	___	___	___	___	___	129	117	109	99	87	77	67	___	___	___	___

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	237				156				112				69				
	233	218	198	181	157	147	135	126	112	102	91	82	69	58	49	40	33
Post trial	230				154				111								
	231	___	___	178	154	145	134	125	111	100	90	81	68	___	___	___	___

#6 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 23¾ OS 51 HVA 59 mm

Rx OD C2.5 % Worn

OS 100 %

PUPIL SIZE START — HIGH 4 mm on, MEDIUM 4.5 mm on, LOW 6.5 mm on

FINISH — HIGH 4 mm on, MEDIUM 4.5 mm on, LOW 6 mm on

OD REFERENCE = 30° = 109

OS REFERENCE = 30° = 112

	HIGH	MEDIUM	LOW
ASCENDING	15° = 180	20° = 155	25° = 135
	20° = 155	22½° = 146	22½° = 146
	15° = 186	22½° = 146	22½° = 146
DESCENDING	30° = 112	35° = 91	35° = 91
	32½° = 101	35° = 91	32½° = 101
	32½° = 101	37½° = 82	32½° = 101
AVERAGE OS		138	119	120

	HIGH	MEDIUM	LOW
ASCENDING	27½° = 118	27½° = 118	25° = 130
	25° = 130	30° = 109	27½° = 118
	25° = 130	27½° = 118	27½° = 118
DESCENDING	35° = 85	37½° = 78	35° = 88
	35° = 88	40° = 68	35° = 88
	37½° = 78	37½° = 78	37½° = 78
AVERAGE OD		105	95	103

	HIGH	MEDIUM	LOW
OD − AVERAGE OS	− 23.48	− 8.77	− 9.61
AVERAGE OD − OS	− 6.45	− 16.43	− 8.37

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	− 15.0%	− 12.6%	− 9.0%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	___	___	___

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40g

LAMPS ON AT 8:05 am DATE 8 Mar 83

START TIME 9:50 am CALIBRATIONS FINISH TIME 11:10 am

Pre-trial Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
201				140				101				63				
200	189	173	157	139	130	126	110	101	91	81	72	63	56	48	40	33
Post trial				141				102								
___	___	___	___	141	132	121	111	102	91	81	73	64	___	___	___	___

Pre-trial Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
201				136				98				61				
202	184	173	156	136	128	119	108	98	88	79	70	60	51	44	36	30
Post trial				138				100								
___	___	174	156	137	129	120	109	100	89	80	71	62	___	___	___	___

#7 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 26¼ OS 39½ HVA 69 mm

Rx OD -3.00 -.37 x 170

OS -4.37 -.50 x 005

% Worn 100%

PUPIL SIZE START: HIGH 4 mm on, MEDIUM 5 mm on, LOW 5½ mm on

FINISH: HIGH 4½ mm on, MEDIUM 5 mm on, LOW 6 mm on

OD REFERENCE = 27½° = 111

OS REFERENCE = 27½° = 109

	HIGH	MEDIUM	LOW
ASCENDING	25° = 120	20° = 137	10° = 174
	27½° = 109	20° = 137	15° = 156
	22½° = 129	22½° = 129	15° = 156
DESCENDING	40° = 61	32½° = 89	25° = 120
	37½° = 71	30° = 99	27½° = 109
	40° = 61	30° = 99	25° = 120
AVERAGE OS	92	115	139

	HIGH	MEDIUM	LOW
ASCENDING	25° = 121	30° = 102	30° = 102
	22½° = 131	30° = 102	27½° = 111
	20° = 140	30° = 102	27½° = 111
DESCENDING	35° = 81	35° = 81	40° = 63
	35° = 81	37½° = 73	40° = 63
	35° = 81	37½° = 73	42½° = 56
AVERAGE OD	106	89	84

	HIGH	MEDIUM	LOW
OD / AVERAGE OS	18.72	-3.54	-22.40
AVERAGE OD / OS	-2.79	-20.20	-25.91

AVERAGE PERCENT DIFFERENCE: HIGH +7.9% MEDIUM -11.9% LOW -24.2%

AVERAGE DIFFERENCE IN LOG_{10} UNITS: HIGH ___ MEDIUM ___ LOW ___

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40h

LAMPS ON AT 10:30 am DATE 10 Mar 83

START TIME 2:45 pm CALIBRATIONS FINISH TIME 4:20 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	198	187	174	156	140	130	120	110	101	92	81	72	64	56	48	41	33
Post trial	196		172	155	138	129	120	110	100	91							

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	216	202	185	168	147	139	129	118	106	97	87	77	67	58	49	40	33
Post trial	215			167	147	138	129	118	107								

#8 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 31 OS 50 HVA 65 mm

Rx OD −.75 −.50 × 88

OS −.75 −.50 × 74

% Worn 10 %

PUPIL SIZE START HIGH 4 mm on MEDIUM 3 mm on LOW 5 mm on

FINISH HIGH 3½ mm on MEDIUM 4½ mm on LOW 5 mm on

OD REFERENCE = 27½° = 110

OS REFERENCE = 30° = 107

	HIGH	MEDIUM	LOW
ASCENDING	15° = 168	15° = 168	20° = 147
	15° = 168	15° = 168	22½° = 139
	15° = 168	15° = 168	22½° = 139
DESCENDING	22½° = 139	20° = 147	25° = 129
	25° = 129	22½° = 139	27½° = 118
	25° = 129	25° = 129	27½° = 118
AVERAGE OS	150	153	132

	HIGH	MEDIUM	LOW
ASCENDING	10° = 173	20° = 139	25° = 120
	15° = 156	15° = 156	27½° = 110
	10° = 173	15° = 156	25° = 120
DESCENDING	25° = 120	27½° = 110	32½° = 92
	22½° = 130	27½° = 110	30° = 101
	22½° = 130	25° = 120	32½° = 92
AVERAGE OD	147	132	106

	HIGH	MEDIUM	LOW
OD / AVERAGE OS	−30.77	−32.70	−18.18
AVERAGE OD / OS	31.5	+20.92	−0.94

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+0.4%	−5.9%	+9.6%
AVERAGE DIFFERENCE IN LOG_{10} UNITS			

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40i

LAMPS ON AT 11:30 am DATE 11 May 83

START TIME 1:45 pm CALIBRATIONS FINISH TIME 3:10 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	209				146				105				67				
	209	197	182	164	145	135	125	115	105	95	85	76	67	58	50	42	34
Post trial	209				146				106								
	210				146		126	115	106	96	85	76	68				

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	221				151				109				68				
	220	205	189	170	150	141	132	120	109	100	90	79	68	59	50	42	34
Post trial									111								
	222					143	134	121	110	100	91						

#9 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 26½ OS 43¾ HVA 66 mm

Rx OD none % Worn

OS ____ %

PUPIL SIZE START — HIGH 4 mm OU, MEDIUM 4 mm OU, LOW 5 mm OU

FINISH — HIGH 3½ mm OU, MEDIUM 4 mm, LOW 4½ mm OU

OD REFERENCE = 30° = 106

OS REFERENCE = 30° = 110

	HIGH	MEDIUM	LOW
ASCENDING	27½ = 121	25° = 133	25° = 133
	25° = 133	22½° = 142	25° = 133
	25° = 133	22½° = 142	25° = 133
DESCENDING	32½° = 100	32½° = 100	27½° = 121
	35° = 91	30° = 110	30° = 110
	35° = 91	30° = 110	30° = 110
AVERAGE OS	112	123	123
OD AVERAGE OS	−5.50	−14.85	−14.85

	HIGH	MEDIUM	LOW
ASCENDING	30° = 106	27½° = 115	32½° = 96
	27½° = 115	27½° = 115	32½° = 96
	27½° = 115	27½° = 115	30° = 106
DESCENDING	32½° = 96	37½° = 76	35° = 85
	35° = 85	37½° = 76	35° = 85
	37½° = 76	35° = 85	37½° = 76
AVERAGE OD	99	97	91
AVERAGE OD OS	−10.53	−12.56	−18.91

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−8.0 %	−14.3 %	−16.9 %
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40j

LAMPS ON AT 11:30 am DATE 11 Mar 83

START TIME 3:20 pm CALIBRATIONS FINISH TIME 4:50 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	205 206	194	179	162	142 143	134	124	114	104 104	93	83	74	65 66	57	49	41	33
Post trial	209 203	191	176	160	142 142	133	123	112	103 102	92	83	74					

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	221 221	206	190	172	151 152	142	132	121	110 110	99	90	79	68 69	59	51	43	34
Post trial	218 218				149 149	140	131	119	108 108	98	89						

#10 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 26 OS 56½ HVA 57 mm

Rx OD +.25 −1.25 × 165 % Worn

OS +.25 −1.75 × 178 100%

PUPIL SIZE

	HIGH	MEDIUM	LOW
START	5½ mm on	6 mm on	7½ mm on
FINISH	6 mm on	6½ mm on	6½ mm on

OD REFERENCE = 27½° = 113

OS REFERENCE = 30° = 109

	HIGH	MEDIUM	LOW
DESCENDING	25° = 132	22½° = 141	25° = 132
	27½° = 120	22½° = 141	30° = 109
	25° = 132	22½° = 141	30° = 109
ASCENDING	35° = 90	32½° = 99	35° = 90
	32½° = 99	32½° = 99	35° = 90
	32½° = 99	35° = 90	35° = 90
AVERAGE OS		112	119	103
OD / AVERAGE OS		−0.89	−5.17	+9.26

	HIGH	MEDIUM	LOW
DESCENDING	5° = 193	26° = 142	20° = 142
	5° = 193	15° = 161	15° = 161
	10° = 178	15° = 161	15° = 161
ASCENDING	35° = 83	25° = 124	37½° = 74
	35° = 83	30° = 103	32½° = 93
	35° = 83	27½° = 113	35° = 83
AVERAGE OD		136	134	119
AVERAGE OD / OS		+22.04	+20.56	+8.77

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+10.6%	+7.7%	+9.0%
AVERAGE DIFFERENCE IN LOG_{10} UNITS			

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40k

LAMPS ON AT 1:30 pm DATE 20 Feb 87

START TIME 3:05 pm CALIBRATIONS FINISH TIME 4:45 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	204	192	177	159	142	132	129	111	102	92	82	74	64	57	48	40	33
	207				141				103				65				
Post trial	199				140	131	121	110	100	90	81	73	63				
									100								

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	212	198	181	165	146	136	127	116	105	96	87	77	66	58	48	40	33
	211				146				105				65				
Post trial	209			164	144	134	125	115	103	95							
					144				103								

#11 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 26 OS 59½ HVA 55 mm

Rx OD −1.25 −.50 × 027 % Worn

OS −1.25 −.50 × 167 90%

PUPIL SIZE START: HIGH 5.5 mm on, MEDIUM 6 mm on, LOW 7 mm on

FINISH: HIGH 5.5 mm on, MEDIUM 6 mm on, LOW 7 mm on

OD REFERENCE = 27½° = 111

OS REFERENCE = 30° = 104

	HIGH	MEDIUM	LOW
ASCENDING	15° = 165	10° = 181	20° = 145
	15° = 165	15° = 165	20° = 145
	15° = 165	15° = 165	15° = 165
DESCENDING	25° = 126	25° = 126	30° = 104
	27½° = 116	25° = 126	32½° = 96
	25° = 126	25° = 126	32½° = 96
AVERAGE OS	144	148	125

	HIGH	MEDIUM	LOW
ASCENDING	32½° = 91	25° = 122	15° = 159
	25° = 122	25° = 122	15° = 159
	30° = 101	27½° = 111	20° = 141
DESCENDING	35° = 82	40° = 64	35° = 82
	37½° = 74	37½° = 74	32½° = 91
	37½° = 74	37½° = 74	35° = 82
AVERAGE OD	91	95	119

	HIGH	MEDIUM	LOW
OD − AVERAGE OS	−25.88	−28.57	−11.86
AVERAGE OD − OS	−13.33	−9.05	+13.45

AVERAGE PERCENT DIFFERENCE: HIGH −19.6% MEDIUM −18.8% LOW +0.8%

AVERAGE DIFFERENCE IN LOG_{10} UNITS: HIGH ____ MEDIUM ____ LOW ____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 401

LAMPS ON AT 7:55 am DATE 15 Mar 83

START TIME 9:40 am CALIBRATIONS FINISH TIME 11:13

Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
198 (197)	186	172	156	138 (137)	129	119	109	100 (101)	89	81	71	63 (63)	55	47	40	33
Post trial																
195	183	170	154	136	126	117	107	98 (98)	88	79	70	62	___	___	___	___

Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
221 (221)	206	189	170	150 (150)	140	131	119	108 (109)	97	88	79	67 (68)	58	49	41	33
Post trial																
217	203	186	168	148 (149)	139	129	119	107 (108)	98	88	79	___	___	___	___	___

#12 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 34½ OS 50¼ HVA 62 mm

Rx OD CL's % Worn

OS 100%

PUPIL SIZE START — HIGH 4 mm OU, MEDIUM 5 mm OU, LOW 5½ mm OU

FINISH — HIGH 4 mm OU, MEDIUM 4½ mm OU, LOW 5 mm OU

OD REFERENCE = 27½° = 108

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
ASCENDING	25° = 130	25° = 130	27½° = 119
	25° = 130	27½° = 119	27½° = 119
	27½° = 119	27½° = 119	30° = 108
DESCENDING	35° = 88	35° = 88	35° = 88
	37½° = 79	37½° = 79	35° = 88
	37½° = 79	37½° = 79	37½° = 79
AVERAGE OS	104	102	100

	HIGH	MEDIUM	LOW
ASCENDING	15° = 155	10° = 171	5° = 185
	15° = 155	10° = 171	5° = 185
	15° = 155	10° = 171	5° = 185
DESCENDING	35° = 80	27½° = 108	25° = 118
	27½° = 108	27½° = 108	22½° = 128
	27½° = 108	25° = 118	22½° = 128
AVERAGE OD	126	141	155

	HIGH	MEDIUM	LOW
OD / AVERAGE OS	+3.77	+5.71	+7.69
AVERAGE OD / OS	+15.38	+26.51	+35.74

AVERAGE PERCENT DIFFERENCE — HIGH +9.6% MEDIUM +16.1% LOW +21.7%

AVERAGE DIFFERENCE IN LOG_{10} UNITS — HIGH ___ MEDIUM ___ LOW ___

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40m

LAMPS ON AT 10:05 am DATE 17 Mar 83

START TIME 12:45 pm CALIBRATIONS FINISH TIME ~~1:40~~ 2:20 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	192 191	179	165	148	132 132	124	115	105	96 97	88	79	69	61 62	54	47	39	33
Post trial	193 193	181	167	151	134 135	126	116	106	97 98	89	80	71	62 63	54	46	39	32

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	214 215	200	185	168	149 148	137	129	118	108 108	97	87	76	67	59 58	49	41	34
Post trial	217	203	186	169	149 149	139	131	120	109 109	98	89	78	68	58	50	42	33

#13 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 29 OS 51 HVA 63 mm

Rx OD C.2.'s % Worn

OS 100 %

PUPIL SIZE START: HIGH 4 mm on, MEDIUM 5 mm on, LOW 5½ mm on

FINISH: HIGH 4 mm on, MEDIUM 4½ mm on, LOW 5½ mm on

OD REFERENCE = 27½° = 106

OS REFERENCE = 30° = 109

	HIGH	MEDIUM	LOW
ASCENDING	10° = 186	22½° = 138	27½° = 119
	15° = 169	25° = 130	22½° = 138
	15° = 169	25° = 130	25° = 130
DESCENDING	37½° = 77	37½° = 77	40° = 68
	35° = 88	35° = 88	37½° = 77
	35° = 88	32½° = 98	37½° = 77
AVERAGE OS	130	110	102

	HIGH	MEDIUM	LOW
ASCENDING	10° = 166	15° = 150	25° = 116
	10° = 166	20° = 133	22½° = 125
	10° = 166	20° = 133	27½° = 106
DESCENDING	25° = 116	35° = 80	40° = 62
	27½° = 106	35° = 80	35° = 80
	27½° = 106	37½° = 70	37½° = 70
AVERAGE OD	138	108	93

	HIGH	MEDIUM	LOW
OD / AVERAGE OS	−20.34	−3.70	+3.85
AVERAGE OD / OS	+23.48	−0.92	−15.84

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+1.6%	−2.3%	−6.0%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40n

LAMPS ON AT 7:45 am DATE 18 Mar 83

START TIME 3:45 pm CALIBRATIONS FINISH TIME 5:20 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	190	179	166	158	134 / 137	125	117	108	99 / 97	88	77	69	62 / 61	52	46	39	32
Post trial	189				135 / 134	124	116	108	97	89	76						

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	207 / 208	195	179	163	143 / 143	134	126	115	106 / 105	95	86	75	67 / 66	58	49	41	34
Post trial	209						127	116	107 / 107	95	86	74	67				

#14 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 28 OS 56 HVA 58 mm

Rx OD C L S % Worn

OS 100%

PUPIL SIZE START: HIGH 4 mm OU, MEDIUM 5 mm OU, LOW 5½ mm OU

FINISH: HIGH 4 mm OU, MEDIUM 4½ mm OU, LOW 5 mm OU

OD REFERENCE = 27½° = 108

OS REFERENCE = 30° = 106

DESCENDING

	HIGH	MEDIUM	LOW
	25° = 127	32½° = 95	25° = 127
	25° = 127	27½° = 116	25° = 127
	25° = 127	27½° = 116	25° = 127
	40° = 67	35° = 86	35° = 86
	40° = 67	37½° = 75	35° = 86
	37½° = 75	37½° = 75	35° = 86
AVERAGE OS	98	94	107
OD / AVERAGE OS	+9.71	+13.86	+0.93

ASCENDING

	HIGH	MEDIUM	LOW
	22½° = 125	20° = 134	20° = 134
	22½° = 125	20° = 134	22½° = 125
	22½° = 125	20° = 134	22½° = 125
	35° = 77	32½° = 89	32½° = 89
	32½° = 89	32½° = 89	32½° = 89
	32½° = 89	35° = 77	32½° = 89
AVERAGE OD	105	110	109
AVERAGE OD / OS	−0.95	+3.70	+2.79

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+4.4%	+8.8%	+1.9 %
AVERAGE DIFFERENCE IN LOG_{10} UNITS			

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 400

LAMPS ON AT 8:02 DATE 23 Mar 83

START TIME 11:45 am CALIBRATIONS FINISH TIME 1:10 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	190	178	166	150	133 (134)	125	116	108	97	88	78	70	61	54	47	40	33
	190								(97)				(61)				
Post trial	188	—	165	150	132 (132)	124	115	107	96	86	—	—	—	—	—	—	—
									(96)								

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	220																
	221	205	189	170	149 (149)	140	131	118	109 (108)	97	88	79	68 (68)	58	49	41	34
Post trial	217	—	—	—	—	—	129	116	107 (107)	96	88	79	67 (67)	57	47	—	—

#15 Exp

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 27 OS 50 HVA 62 mm

Rx OD none % Worn

OS ____ %

PUPIL SIZE START — HIGH 4½ mm, MEDIUM 5 mm, LOW 6 mm

FINISH — HIGH 4 mm, MEDIUM 4½ mm, LOW 5½ mm

OD REFERENCE = 27½° = 108

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
ASCENDING	35° = 88	30° = 108	35° = 88
	30° = 108	25° = 130	30° = 108
	30° = 108	25° = 130	32½° = 97
DESCENDING	42½° = 58	40° = 68	40° = 68
	45° = 48	42½° = 58	40° = 68
	42½° = 58	40° = 68	40° = 68
AVERAGE OS	78	94	83
OD / AVERAGE OS	32.26	13.86	26.18

	HIGH	MEDIUM	LOW
ASCENDING	20° = 133	15° = 150	15° = 150
	15° = 150	20° = 133	20° = 133
	20° = 133	10° = 166	22½° = 125
DESCENDING	30° = 97	30° = 97	30° = 97
	30° = 97	32½° = 87	30° = 97
	27½° = 108	30° = 97	30° = 97
AVERAGE OD	120	122	117
AVERAGE OD / OS	10.53	12.17	8.00

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+21.4%	+13.0%	+17.1%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40p

LAMPS ON AT 8:50 am DATE 17 Feb 83

START TIME 10:15 am CALIBRATIONS FINISH TIME 12:02 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	218 220	206	191	178	152 153	143	133	120	110 111	100	89	79	70 70	61	52	44	36
Post trial	216	—	—	170	151 151	141	131	120	110 110	100	89	—	—	—	—	—	—

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	241 242	226	207	187	164 165	154	143	131	118 118	107	96	85	73 73	63	53	44	35
Post trial	233	—	—	—	158 158	148	138	129	114 114	103	93	83	—	—	—	—	—

#1 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 30 OS 51.5 HVA 63 mm

Rx OD -3.50 -.75 x 70 % Worn

OS -4.00 Sph 100 %

PUPIL SIZE HIGH 4.5 mm ou MEDIUM 4.5 mm ou LOW 5.5 mm ou

OD REFERENCE = 27½° = 120

OS REFERENCE = 30° = 116

	HIGH	MEDIUM	LOW
DESCENDING	27.5° = 130	25° = 141	27.5° = 130
	27.5° = 130	29.5° = 151	30° = 116
	27.5° = 130	25° = 141	25° = 141
ASCENDING	32.5° = 105	35° = 95	35° = 95
	30° = 116	35° = 95	32.5° = 105
	32.5° = 105	35° = 95	35° = 95
AVERAGE OS	119.3	119.6	113.6
OD / AVERAGE OS	0.84	0	5.13

	HIGH	MEDIUM	LOW
DESCENDING	21° = 152	25° = 132	27½° = 142
	20° = 152	22.5° = 142	25° = 132
	20° = 152	25° = 132	25° = 132
ASCENDING	30° = 110	32.5° = 100	35° = 89
	30° = 110	30° = 110	32½° = 100
	30° = 110	32.5° = 100	30° = 110
AVERAGE OD	131	119.3	117.5
AVERAGE OD / OS	12.15	2.55	0.86

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+6.5%	+1.3%	+3.0%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	—	—	—

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40q

LAMPS ON AT 11:45 am DATE 21 Feb 83

START TIME 12:55 CALIBRATIONS FINISH TIME 2:15 pm

Pre-trial Right Channel

226				158				115				73				
227	213	198	179	159	148	137	125	114	103	93	82	73	63	54	46	37

Post trial

219	207	192	173	154	143	134	122	112	101	90	80	71	63	53	44	37
219				154				111				71				
0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50

Pre-trial Left Channel

245				164				117				72				
245	229	209	188	164	153	143	130	118	106	95	84	72	62	52	43	34

Post trial

244	228	210	189	166	156	145	133	120	109	98	86	75	64	55	46	36
244				166				119				74				

BRIGHTNESS TRIAL

SUBJECT [redacted] #2 control PD OD 34.5 OS 32.75 HVA 66 mm

Rx OD none % Worn

OS ____ %

PUPIL SIZE

	HIGH	MEDIUM	LOW
START	3 mm OU	3 mm OU	4 mm OU
FINISH	3 mm OU	3 mm OU	3½ mm OU

OD REFERENCE = 27½° = 124 OS REFERENCE = 30° = 119

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 155	22½° = 155	20° = 165
	20° = 165	25° = 144	25° = 144
	22½° = 155	22½° = 155	25° = 144
DESCENDING	32½° = 108	32½° = 108	32½° = 108
	35° = 97	32½° = 108	35° = 97
	37½° = 85	32½° = 108	32½° = 108
AVERAGE OS	128	130	128
OD / AVERAGE OS	−3.17	−4.72	−3.17

	HIGH	MEDIUM	LOW
ASCENDING	20° = 156	22½° = 145	20° = 156
	22½° = 145	25° = 136	25° = 136
	22½° = 145	25° = 136	20° = 156
DESCENDING	32½° = 102	32½° = 102	32½° = 102
	35° = 92	35° = 92	32½° = 102
	32½° = 102	35° = 92	35° = 92
AVERAGE OD	124	117	124
AVERAGE OD / OS	+4.12	−1.69	+4.12

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+0.5%	−2.8%	+0.5%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40r

LAMPS ON AT 10:00 am DATE 24 Feb 83

START TIME 12:14 pm CALIBRATIONS FINISH TIME 13:46

Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
212	199	186	167	148	138	127	118	109	98	87	77	68	60	51	44	35
Post trial																
215	—	—	—	151	139	131	119	110	100	89	—	—	—	—	—	—

Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
228	215	198	178	156	150	140	126	113	101	92	83	72	61	53	44	35
Post trial																
230	—	—	—	158	149	138	126	114	103	94	—	—	—	—	—	—

#3 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 28.75 OS 44.25 HVA 68 mm

Rx OD −2.50 Sph
OS −2.50 Sph

% Worn 100%

PUPIL SIZE

	HIGH	MEDIUM	LOW
START	3.5 mm on	4 mm on	4.5 mm on
FINISH	3 mm on	4 mm on	4.5 mm on

OD REFERENCE = 27½° = 119

OS REFERENCE = 30° = 114

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 150	25° = 139	25° = 139
	25° = 139	25° = 139	25° = 139
	27½° = 126	25° = 139	27½° = 126
DESCENDING	35° = 93	35° = 93	32½° = 102
	32½° = 102	32.5° = 102	32½° = 102
	32½° = 102	35° = 93	35° = 93
AVERAGE OS	119	118	117
OD / AVERAGE OS	0	0.84	1.69

	HIGH	MEDIUM	LOW
ASCENDING	27½° = 119	25° = 130	25° = 130
	22½° = 139	22½° = 139	25° = 130
	25° = 130	22½° = 139	22½° = 139
DESCENDING	32½° = 99	30° = 110	32½° = 99
	30° = 110	32½° = 99	30° = 110
	30° = 110	32½° = 99	32½° = 99
AVERAGE OD	118	119	118
AVERAGE OD / OS	3.45	4.29	3.45

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+1.8%	+2.6%	+2.6%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	—	—	—

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40s

LAMPS ON AT 0900 am DATE 5 Mar 83

START TIME 2:00 pm CALIBRATIONS FINISH TIME 3:40 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	214				151				111				69				
	215	207	188	169	151	141	130	117	110	99	88	78	69	60	52	43	36
Post trial	212								109								
	212	___	___	___	___	___	128	118	109	99	87	___	___	___	___	___	___

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	229				153				110				69				
	230	216	195	180	154	145	134	125	110	100	91	80	68	58	49	40	33
Post trial	227								108								
	227	___	___	___	___	___	132	124	108	99	90	78	___	___	___	___	___

#4 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 25.5 OS 52.75 HVA 59mm

Rx OD −.75 −.50 × 010

OS −1.50 −.25 × 005

% Worn 50%

PUPIL SIZE

	HIGH	MEDIUM	LOW
START	4.5 mm on	5.5 mm on	6 mm on
FINISH	4.5 mm on	5 mm on	6 mm on

OD REFERENCE = 30° = 110

OS REFERENCE = 30° = 109

	HIGH	MEDIUM	LOW
ASCENDING	25° = 133	25° = 133	25° = 133
	25° = 133	25° = 133	25° = 133
	27½° = 125	25° = 133	27½° = 125
DESCENDING	35° = 91	35° = 91	32½° = 100
	32½° = 100	37½° = 79	35° = 91
	35° = 91	35° = 91	37½° = 79
AVERAGE OS	112	110	110
OD AVERAGE OS	−1.80	0	0

	HIGH	MEDIUM	LOW
ASCENDING	25° = 129	27½° = 118	25° = 129
	25° = 129	25° = 129	27½° = 118
	25° = 129	25° = 129	25° = 129
DESCENDING	35° = 88	35° = 88	35° = 88
	32.5° = 99	35° = 88	35° = 88
	35° = 88	35° = 88	32½° = 99
AVERAGE OD	110	107	109
AVERAGE OD OS	0.91	−1.85	0

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−0.5%	−0.9%	0%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	___	___	___

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40t

LAMPS ON AT 0900 am DATE 5 Mar 83

START TIME 11:15 am CALIBRATIONS FINISH TIME 12:40 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	220	210	192	174	155	144	133	122	113	100	90	81	72	63	52	46	38
Post trial	217	209	191	172	153	142	132	121	111	99	90	81	[redacted]	63	51	4	36

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	226	212	190	173	149	142	131	121	106	99	88	76	64	56	48	40	30
Post trial	224	210	189	171	147	141	130	121	105	99	87	77	64	55	47	40	30

#5 Control

BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 33 OS 56 3/4 HVA 62 mm

Rx OD −.50 −.50 × 180

OS −.75 −.75 × 020

% Worn 25% dist only

PUPIL SIZE START — HIGH 4 mm on, MEDIUM 4 mm on, LOW 5 mm on

FINISH — HIGH 4 mm on, MEDIUM 4.5 mm on, LOW 5 mm on

OD REFERENCE = 30° = 112

OS REFERENCE = 30° = 105

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 142	25° = 131	27½° = 121
	22½° = 142	25° = 131	27½° = 121
	25° = 131	27½° = 121	25° = 131
DESCENDING	37½° = 77	32½° = 99	35° = 88
	35° = 88	37½° = 77	32½° = 99
	37½° = 77	35° = 88	35° = 88
AVERAGE OS	110	108	108
OD / AVERAGE OS	1.80	3.64	3.64

	HIGH	MEDIUM	LOW
ASCENDING	25° = 133	25° = 133	25° = 133
	25° = 133	25° = 133	25° = 133
	22½° = 143	25° = 133	22½° = 143
DESCENDING	35° = 90	35° = 90	32½° = 100
	35° = 90	32½° = 100	35° = 90
	35° = 90	35° = 90	37½° = 81
AVERAGE OD	113	113	113
AVERAGE OD / OS	7.34	7.34	7.34

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	+ 4.6%	+5.5%	+5.5%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40u

LAMPS ON AT 10:30 am DATE 10 Mar 83

START TIME 12:40 CALIBRATIONS FINISH TIME 2:20 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	209 202	198	176	158	142 142	132	124	114	104 104	94	84	75	66 66	58	50	42	35
Post trial	149 199	—	—	—	139 139	129	122	111	102 102	92	83	—	—	—	—	—	—

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	219 219	204	187	169	149 149	139	130	118	107 107	96	87	77	66 66	57	48	40	32
Post trial	217 217	—	—	—	148 149	139	130	119	108 108	97	88	—	—	—	—	—	—

#6 Control BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 32¼ OS 48 HVA 67mm

Rx OD -3.50 -.25 x 177 % Worn

OS -3.00 -.75 x 155 100%

PUPIL SIZE HIGH MEDIUM LOW

START 3 mm OU 4 mm OU 4 mm OU

FINISH 3 mm OU 3½ mm OU 4 mm OU

OD REFERENCE = 27½° = 113

OS REFERENCE = 27½° = 119

ASCENDING

OD HIGH	OD MEDIUM	OD LOW	OS HIGH	OS MEDIUM	OS LOW
27½° = 119	30° = 108	27½° = 119	25° = 123	25° = 123	25° = 123
25° = 130	30° = 108	22½° = 139	22½° = 131	25° = 123	27½° = 113
25° = 130	30° = 108	22½° = 139	25° = 123	25° = 123	25½° = 123

DESCENDING

OD HIGH	OD MEDIUM	OD LOW	OS HIGH	OS MEDIUM	OS LOW
32½° = 97	40° = 66	30° = 108	30° = 103	30° = 103	30° = 103
30° = 108	32½° = 97	32½° = 97	32½° = 93	32½° = 93	30° = 103
32½° = 97	32½° = 97	32½° = 97	30° = 103	32½° = 93	30° = 103
AVERAGE OS 114	97	117	AVERAGE OD 113	110	111
OD / AVERAGE OS -0.88	15.24	-3.48	AVERAGE OD / OS -5.17	-7.86	-6.96

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	-3.0%	+3.7%	-5.2%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	—	—	—

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40v

LAMPS ON AT 9:42 am DATE 14 May 83

START TIME 11:45 am CALIBRATIONS FINISH TIME 1:20 pm

Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
199	187	173	157	140	130	121	109	100	90	82	72	65	56	49	41	34
200				140				101				63				
Post trial																
198	186	172	156	139	129	120	109	100	90	81	72	63	56	48	41	33

Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
219				148				107				69				
220	206	189	170	149	140	130	118	108	98	88	78	69	59	51	42	34
221				150				108				68				
Post trial																
222	208	191	172	151	141	132	120	108	99	89	79	68	59	50	41	34

#7 control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 25¾ OS 47½ HVA 63mm

Rx OD CLs % Worn

OS 100%

PUPIL SIZE START — HIGH 4 mm on, MEDIUM 4½ mm on, LOW 4½ mm on

FINISH — HIGH 4 mm on, MEDIUM 4 mm on, LOW 4½ mm on

OD REFERENCE = 27½° = 109

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 141	25° = 131	25° = 131
	25° = 131	25° = 131	22½° = 141
	25° = 131	25° = 131	25° = 131
DESCENDING	35° = 89	35° = 89	35° = 89
	37½° = 79	32½° = 99	35° = 89
	35° = 89	35° = 89	35° = 89
AVERAGE OS	110	112	112
OD / AVERAGE OS	−0.91	−2.71	−2.71

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 130	20° = 140	22½° = 130
	22½° = 130	22½° = 130	20° = 140
	22½° = 130	22½° = 130	22½° = 130
DESCENDING	32½° = 90	32½° = 90	35° = 82
	32½° = 90	32½° = 90	32½° = 90
	35° = 82	32½° = 90	35° = 82
AVERAGE OD	109	112	109
AVERAGE OD / OS	0.92	3.64	0.92

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	0%	0.5%	−0.9%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40w

LAMPS ON AT 1245 pm DATE 16 Mar

START TIME 3:15 pm CALIBRATIONS FINISH TIME 4:50 pm

Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	197			137				100				64				
	198	187	172	155	138	129	119	109	100	90	86	72	64	56	47	46	33
Post trial									99								
	196					128	117	108	99	84	87						

Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	216			148				109				67				
	217	203	186	169	149	139	130	120	108	97	88	78	67	57	49	41	33
Post trial									107								
	218					139	129	119	107	95	87						

#8 Control

BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 26¼ OS 55 HVA 58 mm

Rx OD −.75 −.25 × 135
OS −.50 −.50 × 045

% Worn distance only %

PUPIL SIZE

	HIGH	MEDIUM	LOW
START	4 mm ou	5 mm ou	6 mm ou
FINISH	4 mm ou	5 mm ou	5½ mm ou

OD REFERENCE = 27½° = 109

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
ASCENDING	25° = 130	25° = 130	25° = 130
	27½° = 120	25° = 130	22½° = 134
	25° = 130	27½° = 120	25° = 130
DESCENDING	30° = 108	35° = 88	32½° = 96
	32½° = 96	32½° = 96	32½° = 96
	35° = 88	35° = 88	30° = 108
AVERAGE OS	112	109	117
OD / AVERAGE OS	−2.71	0	−7.08

	HIGH	MEDIUM	LOW
ASCENDING	25° = 118	22½° = 129	25° = 118
	22½° = 129	22½° = 129	27½° = 109
	25° = 118	22½° = 129	25° = 118
DESCENDING	35° = 87	35° = 87	30° = 100
	35° = 87	32½° = 90	30° = 100
	32½° = 90	32½° = 90	30° = 100
AVERAGE OD	105	109	108
AVERAGE OD / OS	−2.82	+0.92	0

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−2.8%	+0.5%	−3.5%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40x

LAMPS ON AT 7:40 am DATE 18 May 83

START TIME 9:45 am CALIBRATIONS FINISH TIME 11:35 am

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	191 192	181	168	151	137 135	126	116	107	97 97	88	79	70	61 61	54	47	38	32
Post trial	190	—	—	—	134 134	125	116	107	96 96	88	78	69	61 61	54	47	—	—

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	217 217	203	187	169	149 150	140	131	120	109 168	99	89	79	69 68	58	50	42	34
Post trial	217	—	187	169	147 149	139	131	121	108 108	98	—	—	—	—	—	—	—

#9 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 27 OS 50¾ HVA 62mm

Rx OD -3.50 -1.25 x 097 % Worn

OS -3.50 -1.25 x 087 100 %

PUPIL SIZE START — HIGH 4 mm OU; MEDIUM 4½ mm OU; LOW 5 mm OU

FINISH — HIGH 4 mm OU; MEDIUM 4½ mm; LOW 4½ mm OU

OD REFERENCE = 27½° = 107

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
DESCENDING	15° = 169	25° = 131	10° = 187
	20° = 149	25° = 131	10° = 187
	20° = 149	25° = 131	15° = 164
ASCENDING	25° = 131	30° = 108	25° = 131
	27½° = 121	32½° = 99	25° = 131
	25° = 131	32½° = 99	27½° = 121
AVERAGE OS	141	117	154
OD − AVERAGE OS	−27.42	−8.93	−36.02

	HIGH	MEDIUM	LOW
DESCENDING	25° = 116	22½° = 126	35° = 79
	20° = 134	22½° = 126	30° = 97
	20° = 134	20° = 134	30° = 97
ASCENDING	30° = 97	30° = 97	45° = 47
	30° = 97	30° = 97	42½° = 54
	30° = 97	30° = 97	42½° = 54
AVERAGE OD	113	113	71
AVERAGE OD − OS	4.52	4.52	−41.34

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−11.5%	−2.0%	−38.7%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	—	—	—

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40y

LAMPS ON AT 8:02 am DATE 23 Mar 83

START TIME 9:40 am CALIBRATIONS FINISH TIME 11:20 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	193 194	179	167	151	134 135	125	116	108	99 99	89	81	71	62 62	57	48	41	34
Post trial	192				133	123	115	107	98	89	80	71					

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	220 221	206	189	169	148 150	140	130	120	108 109	98	88	79	67 68	58	49	42	34
Post trial	219				148 148	138	129	119	108 108	97	88	79					

#10 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 43 OS 51½ HVA 73 mm

Rx OD −3.25 −.75 × 016 % Worn

OS −4.25 −.50 × 173 100%

PUPIL SIZE START HIGH 3 mm ou MEDIUM 4 mm ou LOW 5 mm ou

FINISH 3 mm ou 4 mm ou 4½ mm ou

OD REFERENCE = 27½° = 108

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 139	25° = 130	22½° = 139
	20° = 148	25° = 130	25° = 130
	25° = 130	27½° = 120	22½° = 139
DESCENDING	35° = 88	37½° = 79	35° = 88
	37½° = 79	37½° = 79	32½° = 98
	35° = 88	35° = 88	32½° = 98
AVERAGE OS	112	104	115
OD / AVERAGE OS	−3.64	3.77	−6.28

	HIGH	MEDIUM	LOW
ASCENDING	20° = 134	25° = 116	25° = 116
	22½° = 124	25° = 116	25° = 116
	22½° = 124	22½° = 124	25° = 116
DESCENDING	30° = 99	35° = 81	32½° = 89
	32½° = 89	35° = 81	32½° = 89
	35° = 81	35° = 81	35° = 81
AVERAGE OD	109	100	101
AVERAGE OD / OS	0.92	−7.69	−6.70

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−1.4%	−2.0	−6.5%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40z

LAMPS ON AT 8:02 am DATE 23 Mar 83

START TIME 1:51 pm CALIBRATIONS FINISH TIME 3:10 pm

Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial				134				99				62				
192	178	165	150	133	124	115	107	98	89	80	71	62	56	48	41	34
191																
Post trial				132				97								
190				132	122	114	106	97	88	80	70					

Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial				150				110				69				
219	206	190	172	151	142	132	122	111	100	91	79	69	59	51	43	35
220																
Post trial				150				110								
218				150	141	131	122	110	99	90	78					

#11 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 34¾ OS 56 HVA 64 mm

Rx OD +.25 −1.25 × 180 % Worn

OS pl − .50 × 180 75%

PUPIL SIZE START: HIGH 4 mm on, MEDIUM 5 mm on, LOW 5 mm on

FINISH: HIGH 4 mm on, MEDIUM 4½ mm on, LOW 4½ mm on

OD REFERENCE = 27½° = 107

OS REFERENCE = 30° = 110

	HIGH	MEDIUM	LOW
ASCENDING	25° = 132	25° = 132	20° = 150
	25° = 132	22½° = 142	25° = 132
	22½° = 142	25° = 132	25° = 132
DESCENDING	35° = 91	35° = 91	35° = 91
	35° = 91	35° = 91	37½° = 79
	35° = 91	37½° = 74	35° = 91
AVERAGE OS	113	111	113
OD / AVERAGE OS	−5.45	−3.67	−5.45

	HIGH	MEDIUM	LOW
ASCENDING	20° = 133	22½° = 123	20° = 133
	22½° = 123	22½° = 123	22½° = 123
	22½° = 123	22½° = 123	22½° = 123
DESCENDING	35° = 80	35° = 80	37½° = 89
	32½° = 89	35° = 80	32½° = 89
	32½° = 89	32½° = 84	35° = 80
AVERAGE OD	106	103	106
AVERAGE OD / OS	−3.70	−6.57	−3.70

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−4.6%	−5.1%	−4.6%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40aa

LAMPS ON AT 8:35 am DATE 24 Mar 83

START TIME 10:40 am CALIBRATIONS FINISH TIME 12:15 pm

Right Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
195	180	166	151	135 134	124	115	108	100 99	90	80	72	63 63	55	48	41	34
Post trial																
191	___	___	___	___	123	114	107	99 99	89	80	___	___	___	___	___	___

Left Channel

0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial																
224	208	192	173	152 153	143	134	123	112 112	101	92	81	70 70	59	51	43	35
Post trial																
220	___	___	___	___	141	133	121	111 111	100	90	80	69	___	___	___	___

#12 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 29¼ OS 53½ HVA 62 mm

Rx OD −2.50 −.50 × 106 % Worn

OS −2.00 Sph 100 %

PUPIL SIZE START — HIGH 3 mm on, MEDIUM 4 mm on, LOW 4½ mm on

FINISH — HIGH 3½ mm on, MEDIUM 4 mm on, LOW 4½ mm on

OD REFERENCE = 27½° = 108

OS REFERENCE = 30° = 112

	HIGH	MEDIUM	LOW
ASCENDING	25° = 134	25° = 134	25° = 134
	27½° = 122	25° = 134	22½° = 142
	27½° = 122	22½° = 142	22½° = 142
DESCENDING	40° = 70	37½° = 81	35° = 91
	37½° = 81	37½° = 81	35° = 91
	37½° = 81	35° = 91	35° = 91
AVERAGE OS	102	111	115
OD / AVERAGE OS	5.71	−2.74	−6.28

	HIGH	MEDIUM	LOW
ASCENDING	22.5° = 124	22½° = 124	25° = 115
	25° = 115	22½° = 124	22½° = 124
	22.5° = 124	22½° = 124	22½° = 124
DESCENDING	35° = 80	35° = 80	32½° = 90
	32½° = 90	32½° = 90	32½° = 90
	32½° = 90	32½° = 90	32½° = 90
AVERAGE OD	104	105	106
AVERAGE OD / OS	−7.41	−6.45	−5.50

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−0.9%	−4.6%	−5.9%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	___	___	___

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40bb

LAMPS ON AT 8:35 am DATE 24 Mar 83

START TIME 12:45 pm CALIBRATIONS FINISH TIME 2:20 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	192 193	179	164	151	131 132	123	116	107	98 98	88	80	71	62 63	56	49	42	34
Post trial	191				130 131	123	115	106	98 98	88	80	71					

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	219 220	206	189	171	150 151	141	132	120	109 109	99	90	80	69 69	59	50	41	34
Post trial	220				150 150	141	132	121	110 110	99	90	79					

#13 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 28 OS 55 HVA 58 mm

Rx OD −.75 Sph

OS −.75 Sph

% Worn 0 %

PUPIL SIZE START — HIGH 5 mm on, MEDIUM 6 mm on, LOW 7 mm on

FINISH — HIGH 5 mm on, MEDIUM 5½ mm on, LOW 6½ mm on

OD REFERENCE = 27½° = 107

OS REFERENCE = 90° = 110

ASCENDING

	HIGH	MEDIUM	LOW
	25° = 132	25° = 132	20° = 150
	25° = 132	25° = 132	25° = 132
	27½° = 121	25° = 132	20° = 150

DESCENDING

	HIGH	MEDIUM	LOW
	35° = 90	37½° = 80	37½° = 80
	37½° = 80	35° = 90	37½° = 80
	37½° = 80	35° = 90	37½° = 80
AVERAGE OS	106	109	112
OD / AVERAGE OS	0.94	−1.85	−4.57

ASCENDING

	HIGH	MEDIUM	LOW
	20° = 131	22½° = 123	20° = 131
	20° = 131	22½° = 123	25° = 116
	22½° = 123	25° = 116	27½° = 107

DESCENDING

	HIGH	MEDIUM	LOW
	35° = 80	37½° = 71	37½° = 71
	32½° = 88	35° = 80	35° = 80
	32½° = 88	35° = 80	32½° = 88
AVERAGE OD	107	99	99
AVERAGE OD / OS	−2.76	−10.53	−10.53

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−0.9%	−6.2%	−7.6%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40cc

LAMPS ON AT 4:30 pm DATE 24 Mar 83

START TIME 7:40 pm CALIBRATIONS FINISH TIME 8:45 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	191	191	179	167	150	174 134	125	117	108	98 97	88	77	69	62 62	52	46	39	32
Post trial	190					133	125	116	108	97	88	76	68					

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	217 218	218	203	188	170	149	140	131	119	109 108	98	89	78	69 69	59	51	43	34
Post trial	215					138	129	117	107 107	97	88	78						

#14 Control

BRIGHTNESS TRIAL

SUBJECT [redacted]

PD OD 26 OS 46 HVA 65 mm

Rx OD −4.00 −1.00 × 110 % Worn

OS −3.50 −.50 × 050 100 % dist

PUPIL SIZE START: HIGH 3 mm on MEDIUM 4 mm on LOW 5 mm on

FINISH: HIGH 3½ mm on MEDIUM 4 mm on LOW 4 mm on

OD REFERENCE = 27½° = 108

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
ASCENDING	25° = 130	25° = 130	25° = 130
	27½° = 118	25° = 130	22½° = 134
	25° = 130	25° = 130	22½° = 134
DESCENDING	32½° = 98	35° = 89	35° = 89
	35° = 89	32½° = 98	37½° = 78
	35° = 89	35° = 89	37½° = 78
AVERAGE OS	109	111	109
OD / AVERAGE OS	−0.92	−2.74	−0.92

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 125	22½° = 125	20° = 134
	25° = 117	22½° = 125	22½° = 125
	22½° = 125	22½° = 125	22½° = 125
DESCENDING	32½° = 88	35° = 77	35° = 77
	32½° = 88	35° = 77	32½° = 88
	30° = 97	37½° = 69	32½° = 88
AVERAGE OD	107	100	106
AVERAGE OD / OS	−0.93	−7.69	−1.87

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	−0.9%	−5.2%	−1.4%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

COMPARATIVE MONOCULAR CONTRIBUTIONS TO BRIGHTNESS (C M C B) DATA SHEET 40dd

LAMPS ON AT 12:05 pm DATE 28 Mar 83

START TIME 2:45 CALIBRATIONS FINISH TIME 4:30 pm

Right Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	196 197	185	171	156	137	128	119	108	99 100	89	81	70	62 63	54	47	40	33
Post trial	195				135 135	127	118	107	98 98	88	80	70					

Left Channel

	0	5	10	15	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45	47.5	50
Pre-trial	220 221	207	190	170	150 150	139	131	119	108 109	97	88	78	68 68	57	49	41	33
Post trial						137	130	117	107 107	96	87						

#15 Control

BRIGHTNESS TRIAL

SUBJECT [redacted] PD OD 31¼ OS 52½ HVA 63mm

Rx OD -5.25 -.25 × 153 % Worn

OS -5.25 Sph 100%

PUPIL SIZE	HIGH	MEDIUM	LOW
START	3 mm on	4 mm on	4 mm on
FINISH	3 mm on	4 mm on	4 mm on

OD REFERENCE = 27½° = 108

OS REFERENCE = 30° = 108

	HIGH	MEDIUM	LOW
ASCENDING	22½° = 138	22½° = 138	25° = 131
	25° = 131	25° = 131	25° = 131
	22½° = 138	25° = 131	22½° = 138
DESCENDING	32½° = 97	32½° = 97	30° = 108
	32½° = 97	35° = 88	30° = 108
	30° = 108	32½° = 97	30° = 108
AVERAGE OS	118	114	121
OD / AVERAGE OS	-8.85	-5.41	-11.35

	HIGH	MEDIUM	LOW
ASCENDING	20° = 136	22½° = 128	20° = 136
	22½° = 128	22½° = 128	20° = 136
	20° = 136	20° = 136	22½° = 128
DESCENDING	32½° = 89	35° = 81	35° = 81
	35° = 81	35° = 81	37½° = 70
	32½° = 89	35° = 91	35° = 81
AVERAGE OD	110	106	105
AVERAGE OD / OS	1.85	-1.87	-2.82

	HIGH	MEDIUM	LOW
AVERAGE PERCENT DIFFERENCE	-3.5%	-3.6%	-7.1%
AVERAGE DIFFERENCE IN LOG_{10} UNITS	____	____	____

APPENDIX D

PRELIMINARY EXAMINATION FORMS

Exp #1

DATE 25 Feb 83

41a

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 2-27-51

VISUAL ACUITY

UNAIDED	OD 20/100	AIDED	OD 20/20	HABITUAL Rx OD	−1.00 −1.25 × 025
	OS 20/100		OS 20/20	OS	−1.25 −1.50 × 140

Rx DATE 6-81

% WORN 100

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 4½ inches OS 4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'
LATERAL 1 eso
VERTICAL —0—

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD

No apparent pathology
c/d .2
Macular reflex present

OS

No apparent pathology
c/d .2
Macular reflex present

ADDITIONAL REMARKS:

right eye dom

DATE 17 Feb 83

Exp #2

41b

SUBJECT NAME [redacted] M (F) DATE OF BIRTH Mar 9, 41

VISUAL ACUITY

		UNAIDED	AIDED
	OD	20/100	20/20
	OS	20/50	20/20

HABITUAL Rx

OD -1.62 Sph
OS -.87 Sph

Rx DATE 5/79

% WORN 100

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 8 inches OS 9 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL 1 x o

VERTICAL ~~e~~

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD

No opp pathology
c/d .4
macular reflex present

OS

No opp pathology
c/d .4
macular reflex present

ADDITIONAL REMARKS:

left eye dom

Exp #3

DATE 28 Feb 83

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 4-8-59

41c

VISUAL ACUITY

UNAIDED	OD	20/20	AIDED	OD	20/	
	OS	20/20		OS	20/	

HABITUAL Rx

OD	none
OS	

Rx DATE ____

% WORN ____

AIDED STEREOACUITY (Randot) 50 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 5 inches OS 5 inches (w/o habitual Rx)

SUBJECTIVE REFRACTION

OD	+.25 Sph	20/no ph	
OS	+.12 Sph	20/no ph	

PHORIAS AT 20'
LATERAL Ø
VERTICAL Ø

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No appo pathology	No appo pathology
Macular reflex present	Macular reflex present
C/D .2	C/D .2

ADDITIONAL REMARKS:

right eye dom

DATE 28 Feb 83

Exp #4

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 13 Jun 59 41d

VISUAL ACUITY

UNAIDED	OD	20/100	AIDED	OD	20/15
	OS	20/60		OS	20/15

HABITUAL Rx

OD -.75 -.75 x 008

OS -.75 -.50 x 002

Rx DATE Sept 82

% WORN 50% distance

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 13/14 pass

OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 7 inches OS 6 inches

~~(with habitual Rx)~~ no Rx

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL ∅

VERTICAL —0—

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No app pathology	No app pathology
C/D .2	C/D .2
Macula reflex present	Macula reflex present

ADDITIONAL REMARKS: right eye dom

Wed 2:00

DATE 3 Mar 83

Exp #5

SUBJECT NAME [redacted] Ⓜ F DATE OF BIRTH 4-29-58 41e

VISUAL ACUITY

UNAIDED	OD	20/20	AIDED	OD	20/	OD
	OS	20/20		OS	20/	OS

HABITUAL Rx none Rx DATE ____ % WORN ____

AIDED STEREOACUITY (Randot) 50 arcseconds
vertical found in Suty tried but no improvement

COLOR VISION OD 14/14 pass OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 3½ inches OS 3½ inches
~~(with habitual Rx)~~
no Rx

PHORIAS AT 20'

SUBJECTIVE REFRACTION OD +1.12 20/20+ LATERAL 3 eso
OS +1.12 Sph. 20/20+ VERTICAL ½ L hyper
screening exf

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No opp pathology	No opp pathology
C/D .1	C/D .1
Macula reflex present	Macula reflex present

ADDITIONAL REMARKS:
6:00 Wed 7 Mar 83 Right eye dom

DATE 5 Mar 83

Exp # 6

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 10 May 44 41f

VISUAL ACUITY

UNAIDED	OD	20/ 300	AIDED	OD	20/ 20	OD
	OS	20/ 300		OS	20/ 20	OS

HABITUAL Rx CL's

Rx DATE 9/82

% WORN 100

AIDED STEREOACUITY (Randot) 50 arcseconds

COLOR VISION OD 12/14 pass
OS 12/14 pass

DONDERS ACCOMMODATION (monocular) OD 6 inches OS 6 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL 1 x

VERTICAL 0

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No opp pathology	No opp pathology
c/d .3	c/d .3
Macular reflex present	macular reflex present

ADDITIONAL REMARKS:

Right eye dom

DATE 1 Mar 83

Exp #7

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 6-25-53 41g

VISUAL ACUITY

UNAIDED	OD	20/125	AIDED	OD	20/25+
	OS	20/200		OS	20/25+

HABITUAL Rx

OD -3.00 -.37 x 170
OS -4.37 -.50 x 005

Rx DATE 2/83
% WORN 100

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 3½ inches OS 3½ inches (with habitual Rx)

SUBJECTIVE REFRACTION OD -3.00 -.50 x 116 20/20
OS -4.50 -.50 x 180 20/20

PHORIAS AT 20'
LATERAL 1 eso
VERTICAL ½ L hyper

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD

No opp pathology
C/D .5 mod deep
Macula reflex present

OS

No opp pathology
C/D .5 mod deep
Macula reflex present

ADDITIONAL REMARKS:

Tues 8 Mar 10:00
right eye dom

DATE 4 Mar 83

Exp #8

41h

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 11-19-55

VISUAL ACUITY

		UNAIDED	AIDED
	OD	20/70	20/20
	OS	20/70	20/20

HABITUAL Rx

OD -.75 -.50 x 88

OS -.75 -.50 x 74

Rx DATE ? 78

% WORN 10%

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 4 inches OS 4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD -.75 -.62 x 90 20/20

OS -.75 -.87 x 81 20/20

PHORIAS AT 20'

LATERAL 1 eso

VERTICAL 0

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No ogp pathology	No ogp pathology
C/D .2	C/D .2
Macular reflex present	Macular reflex present

ADDITIONAL REMARKS:

left eye dom

DATE 4 Mar 83

Exp #9

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 12-20-57 41i

VISUAL ACUITY

UNAIDED	OD	20/20	AIDED	OD	20/	
	OS	20/20-1		OS	20/	

HABITUAL Rx

OD	none	Rx DATE
OS		% WORN

AIDED STEREOACUITY (Randot) 50 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 6 inches OS 5½ inches (with habitual Rx)

SUBJECTIVE REFRACTION OD +.25 -.75 x 167 20/20+
OS +.50 -.50 x 20 20/20+

PHORIAS AT 20'
LATERAL 3 x o
VERTICAL ⊖

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No opp pathology	No opp pathology
c/d .2	c/d .2
Macula reflex present	Macula reflex present

ADDITIONAL REMARKS:
right eye dom

DATE 8 Mar 83

Exp #10

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 7-27-59 41j

VISUAL ACUITY

UNAIDED	OD	20/50	AIDED	OD	20/20
	OS	20/80		OS	20/20

HABITUAL Rx

OD +4.25 -1.25 x 165
OS +4.25 -1.95 x 178

Rx DATE 2/82
% WORN 100

AIDED STEREOACUITY (Randot) 50 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 6 inches OS 6 inches (with habitual Rx)

SUBJECTIVE REFRACTION

OD pl -.75 x 172 20/20
OS +.37 -1.75 x 004 20/20

PHORIAS AT 20'
LATERAL 1 eso
VERTICAL .37 L hyper

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No opp pathology	No opp pathology
C/D .1	C/D .1
Macula reflex present	Macula reflex present

ADDITIONAL REMARKS: Left eye dom

DATE 20 Feb 89

Exp #11

41k

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 12-3-55

VISUAL ACUITY

		UNAIDED	AIDED
	OD	20/150	20/20
	OS	20/150	20/20

HABITUAL Rx

OD -1.25 -.50 x 027

OS -1.25 -.50 x 167

Rx DATE 3/82

% WORN 90%

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 14/14

OS 14/14

DONDERS ACCOMMODATION (monocular) OD 3½ inches OS 3½ inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL ϕ

VERTICAL ~~ϕ~~

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD

No ogp pathology
Macula reflex present

OS

No ogp pathology
Macula reflex present

ADDITIONAL REMARKS: left eye dom

DATE 10 Mar 83

* Exp #12

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 12-6-55 411

VISUAL ACUITY

UNAIDED	OD	20/400	AIDED	OD	20/20	OD
	OS	20/400		OS	20/20	OS

HABITUAL Rx CL's

Rx DATE 10/82

% WORN 100%

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 3 inches OS 3 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD +1.37 -.50 x 007 20/20

OS +.50 -.12 x 180 20/20

PHORIAS AT 20'
LATERAL Ø
VERTICAL Ø

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD

No agg pathology
C/D .3
Macula reflex present

OS

No agg pathology
C/D .3
macula reflex present

ADDITIONAL REMARKS:
right eye dom

DATE 9 Mar 83

41m

* Exp #17

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 10-24-59

VISUAL ACUITY

UNAIDED	OD	20/ 400	AIDED	OD	20/20 +1	OD
	OS	20/ 400		OS	20/2. +2	- OS

HABITUAL Rx

C.L.s

Rx DATE 2/83

% WORN 100

AIDED STEREOACUITY (Randot) 50 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 5 inches OS 4 3/4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD +.12 -.37 x 90 20/20 +1
over CL.
OS +.25 -.37 x 71 20/2. +1

PHORIAS AT 20'
LATERAL 5 x.
VERTICAL -0-

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD
No opp pathology
C/D .3
Macula reflex present

OS
No opp pathology
C/D .3
Macula reflex present

ADDITIONAL REMARKS:

Spectacle Rx OD -3.00 Sph
OS -3.00 Sph

Right eye dom

DATE 16 Mar 83

Exp #14

41n

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 11-20-57

VISUAL ACUITY

UNAIDED	OD	20/200	AIDED	OD	20/20	HABITUAL Rx OD	C.L.'s
	OS	20/200		OS	20/20	OS	PMMA

Rx DATE 77

% WORN 100

AIDED STEREOACUITY (Randot) 50 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 4 inches OS 4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'
LATERAL ϕ
VERTICAL -0-

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD

No opp pathology
C/D .1-
Macula reflex present

OS

No opp pathology
C/D .1-
Macula reflex present

ADDITIONAL REMARKS:

right eye dom

DATE 15 May 83

Exp #15

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 2-9-58 41o

VISUAL ACUITY

UNAIDED	OD	20/20⁺	AIDED	OD	20/	
	OS	20/20⁺		OS	20/	

HABITUAL Rx

OD	none
OS	

Rx DATE

% WORN

AIDED STEREOACUITY (Randot) 70 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 5 inches OS 5 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD +.25 -.37 x 112 20/20⁺
OS +.25 -.25 x 45 20/20⁺

PHORIAS AT 20'
LATERAL 4 eso
VERTICAL 0

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No opp pathology C/D .2 Macula reflex present	No opp pathology C/D .2 Macular reflex present

ADDITIONAL REMARKS:

left eye dom

DATE 17 Feb 83

Con #21

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 2 Oct 57 41p

VISUAL ACUITY

UNAIDED	OD	20/400	AIDED	OD	20/20	HABITUAL Rx: OD -3.50 -.75 x 70
	OS	20/400		OS	20/20	OS -4.00 sph

Rx DATE 6/81

% WORN 100%

AIDED STEREOACUITY (Randot) 25 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 Pass

DONDERS ACCOMMODATION (monocular) OD 4 inches OS 4 1/4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/~~20~~

OS 20/~~20~~

PHORIAS AT 20'
LATERAL ϕ
VERTICAL -0-

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No appr pathology C/D .2 Macular rflex present	No appr pathology C/D .3 Macular rflex present

ADDITIONAL REMARKS:
left eye dom

DATE 21 Feb 83

Con #2

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 9-22-25 41q

VISUAL ACUITY

UNAIDED	OD	20/20	AIDED	OD 20/	OD
	OS	20/20+3		OS 20/	OS

HABITUAL Rx

Rx DATE ____

% WORN ____

AIDED STEREOACUITY (Randot) 40 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 14½ inches OS 14½ inches
(with ~~Habitual Rx~~ +2.00 Sph OU)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'
LATERAL 4 xo
VERTICAL 1.25 B upos

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No opp pathology	No opp pathology
Macular reflex present	Macular reflex present

ADDITIONAL REMARKS:

right eye dom

DATE 24 Feb 83

Con #3

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 16 Sep 49 41r

VISUAL ACUITY

		UNAIDED	AIDED	HABITUAL Rx
	OD	20/300	20/20+	-2.50 sph
	OS	20/300	20/20+	-2.50 sph

Rx DATE 1/82

% WORN 100%

AIDED STEREOACUITY (Randot) 30 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 4 inches OS 4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'
LATERAL 3x.
VERTICAL 0

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No opp pathology	No opp pathology
Macular reflex present	Macular reflex present

ADDITIONAL REMARKS:
right eye dom

DATE 23 Feb 83

Con #4

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 7 Oct 65 41s

VISUAL ACUITY

		UNAIDED	AIDED
	OD	20/40	20/20
	OS	20/100	20/20

HABITUAL Rx

OD -.75 -.50 x 10
OS -1.50 -.25 x 005

Rx DATE 1/80
% WORN 50%

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 3 inches OS 3 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'
LATERAL 1 es
VERTICAL -0-

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD
No opp pathology
C/D .3
Macular reflex present

OS
no opp pathology
C/D .3
Macular reflex present

ADDITIONAL REMARKS:

Rx mainly for distance.
right eye dom

Con #5

DATE 23 Feb 83

41t

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 11-11-37

VISUAL ACUITY

UNAIDED	OD	20/40	AIDED	OD	20/20
	OS	20/40		OS	20/20

HABITUAL Rx

OD -.50 -.50 x 18°
OS -.75 -.75 x 020

Rx DATE 1-83

% WORN 25% dist only

AIDED STEREOACUITY (Randot) 30 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 6½ inches OS 7 inches
(~~with habitual Rx~~) w/o Rx

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'
LATERAL Ø
VERTICAL -0-

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD
No opp pathology
C/D .3
Macula reflex present

OS
No opp pathology
C/D .3
Macula reflex present

ADDITIONAL REMARKS:
left eye dom

Con #6

DATE 3 May 83

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 2-8-50 41u

VISUAL ACUITY

UNAIDED	OD	20/250	AIDED	OD	20/20
	OS	20/250		OS	20/20

HABITUAL Rx

OD -3.50 -.25 × ~~087~~

OS -3.00 -.75 × 155

Rx DATE 2/83

% WORN 100

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 3½ inches OS 3½ inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL 1 eso

VERTICAL .75 2 hyper

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD

no appo pathology
c/d .3-
Macula reflex present

OS

no appo pathology
c/d .3-
Macula reflex present

ADDITIONAL REMARKS:

right eye dom

Con #7

DATE 7 Mar 83

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 11-24-56 41v

VISUAL ACUITY

UNAIDED	OD	20/800	AIDED	OD	20/20	OD
	OS	20/800		OS	20/20	OS

HABITUAL Rx

C.L.
B+L u4's

Rx DATE 11/82
% WORN 100%

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 14/14
OS 14/14

DONDERS ACCOMMODATION (monocular) OD 3 inches OS 3½ inches (with habitual Rx)

SUBJECTIVE REFRACTION own CL

OD +.12 -.50 x 057 20/
OS pl -.25 x 162 20/

PHORIAS AT 20'
LATERAL 1 x.
VERTICAL ½ L hyper

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
~~ctk~~ No app pathology C/D .1 Macula reflex present	No app pathology C/D .1 Macula reflex present

ADDITIONAL REMARKS:
left eye dom

Con #8

DATE 16 Mar 83

41w

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 5-15-57

VISUAL ACUITY

HABITUAL Rx

UNAIDED OD 20/60 AIDED OD 20/20 OD -.75 -.25 x 135 Rx DATE 2/83

OS 20/60 OS 20/20 OS -.50 -.50 x 45 % WORN distance only

AIDED STEREOACUITY (Randot) 20 arcseconds COLOR VISION OD 14/14 pass

OS 14/14 pass

DONDERS ACCOMMODATION OD 3½ inches OS 3½ inches
(monocular) (with habitual Rx)

PHORIAS AT 20'

SUBJECTIVE REFRACTION OD not done 20/ LATERAL 4 eso

OS 20/ VERTICAL 0

OCULAR MEDIA OD central clear with cortical congenital cataracts OS central clear with cortical congenital cataract

FUNDUS EVALUATION

OD

no app pathology
C/D .3
macula reflex present

OS

no app pathology
C/D .3
macula reflex present

ADDITIONAL REMARKS:
right eye dom

DATE 18 Mar 83

Con #9

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 9-8-28 41x

VISUAL ACUITY

UNAIDED	OD	20/350	AIDED	OD	20/20	HABITUAL Rx: OD -3.50 -1.25 x097
	OS	20/350		OS	20/20	OS -3.50 -1.25 x087

Rx DATE 6/81

% WORN 100

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 10½ inches OS 11 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'
LATERAL 2xo
VERTICAL —0—

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD
No opp pathology
C/D .2
Macular reflex present

OS
No opp pathology
C/D .2+
Macular reflex present

ADDITIONAL REMARKS:
left eye dom

Con # 10

DATE 18 Mar 83

SUBJECT NAME [redacted] (M) F DATE OF BIRTH Aug 22, 52 41y

VISUAL ACUITY

UNAIDED	OD	20/400	AIDED	OD	20/20
	OS	20/400		OS	20/20

HABITUAL Rx

OD -3.25 - .75 x 016

OS -4.25 - .50 x 173

Rx DATE 10/82

% WORN 100%

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 12/14 pass

OS 12/14 pass

DONDERS ACCOMMODATION (monocular) OD 6 inches OS 5 3/4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL ϕ

VERTICAL —

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No appr pathology	No appr pathology
C/D .4 towards temporal	C/D .4 towards temporal
Macula reflex present	Macula reflex present

ADDITIONAL REMARKS: left eye dom

Call after 1800 hrs

DATE 23 Mar 83

Con #11

SUBJECT NAME [redacted] Ⓜ F DATE OF BIRTH 11-30-43 41z

VISUAL ACUITY

UNAIDED	OD	20/100	AIDED	OD	20/20
	OS	20/30		OS	20/20

HABITUAL Rx

OD +.25 −1.25 x 180
OS pl −.50 x 180

Rx DATE 2/81
% WORN 75%

AIDED STEREOACUITY (Randot) 40 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 6 inches OS 6 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/
OS 20/

PHORIAS AT 20'
LATERAL 2 x o
VERTICAL ½ L hyper

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD
No opp pathology
C/D .3
Macular reflex present

OS
No opp pathology
C/D .3
Macular reflex present

ADDITIONAL REMARKS:
right eye dom

Con #12

DATE 24 Mar 83

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 12-14-45 41aa

VISUAL ACUITY

UNAIDED	OD	20/50⁻	AIDED	OD	20/20
	OS	20/50		OS	20/20

HABITUAL Rx

OD −2.50 −.50 x 106
OS −2.00 Sph

Rx DATE 11/82
% WORN 100

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 13/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 7½ inches OS 8 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/
OS 20/

PHORIAS AT 20'
LATERAL ∅
VERTICAL —O—

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD
No opp pathology
C/D .2
Macular reflex present

OS
No opp pathology
C/D .2
Macular reflex present

ADDITIONAL REMARKS:
Left eye dom

DATE 16 Mar 83

Con #13

41bb

SUBJECT NAME [redacted] M (F) DATE OF BIRTH 1-15-58

VISUAL ACUITY

UNAIDED	OD	20/30	AIDED	OD	20/20	HABITUAL Rx: OD -.75 Sph
	OS	20/30+2		OS	20/20	OS -.75 Sph

Rx DATE 6/81

% WORN 0

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 14/14 pass
OS 13/14 pass

DONDERS ACCOMMODATION (monocular) OD 4 inches OS 4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD -.75 -.50 x 160 20/20

OS -.25 -.50 x 180 20/20

PHORIAS AT 20'
LATERAL Ø
VERTICAL -0-

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No ogp pathology	No ogp pathology
C/D .2	C/D .2
Macula reflex present	Macula reflex present

ADDITIONAL REMARKS:

left eye dom

Con # 14

DATE 24 Mar 83

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 6-16-48 41cc

VISUAL ACUITY

UNAIDED	OD	20/200	AIDED	OD	20/20
	OS	20/200		OS	20/20

HABITUAL Rx

OD -4.00 -1.00 x 110

OS - 3.50 -.50 x 050

Rx DATE 6/81

% WORN Full Time ex Reading

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 14/14 pass
OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 7 inches OS 7 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL 1 exo

VERTICAL -0-

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
no appathology c/d not obscured Macula reflex present	no appathology c/d not obscured Macula reflex present

ADDITIONAL REMARKS:

right eye dom

Con # 15

DATE 14 Mar 83

SUBJECT NAME [redacted] (M) F DATE OF BIRTH 26 May 49 41dd

VISUAL ACUITY

UNAIDED	OD	20/600	AIDED	OD	20/20
	OS	20/600		OS	20/20

HABITUAL Rx

OD -5.25 -.25 x 157

OS -5.25 Sph

Rx DATE 7/82

% WORN 100%

AIDED STEREOACUITY (Randot) 20 arcseconds

COLOR VISION OD 14/14 pass

OS 14/14 pass

DONDERS ACCOMMODATION (monocular) OD 4 inches OS 4 inches (with habitual Rx)

SUBJECTIVE REFRACTION OD not done 20/

OS 20/

PHORIAS AT 20'

LATERAL 3 xo

VERTICAL 1/4 L hyper.

OCULAR MEDIA OD all clear OS all clear

FUNDUS EVALUATION

OD	OS
No app pathology	No app pathology
C/D .3+ deep	C/D .3+ deep
Macula reflex present	Macula reflex present

ADDITIONAL REMARKS:

right eye dom